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From Small Beginnings

BECAUSE chemical industry on the Pacific Coast is younger and less highly organized than in some other sections of the country, it offers an unusual opportunity to observe the current trends of industrial development. At a time when mergers and consolidations in the East have built up large accumulations of capital and diversified manufacturing interests, it is significant that many of the outstanding successes in Western industry are among the smaller companies.

THIS RAISES some very natural questions: Have our industrial giants become too unwieldy, too cumbersome and inflexible to take full advantage of existing opportunities? Is the burden of excessive overhead a handicap that is holding back the more rapid progress of chemical industry in translating the results of research into profitable commercial enterprises? Perhaps the best answer to these questions will be found in a study of recent trends.

FIRST, and most impressive, is the growth of the small plant strategically located to capitalize on a local resource—raw material, market, or human enterprise. Next is the decentralizing of the industry that comes from the establishment of branch plants to serve a particular territory or trade. And, somewhat related to both of these is the transfer of production to subsidiary companies designed to supply the requirements of a single customer or a closely allied group. Small sulphuric-acid plants are being built to serve certain oil refineries. Most of the larger viscose plants now obtain their carbon bisulphide from adjacent enterprises. Alum, salt cake, and other chemicals for the paper maker are being manufactured in close proximity to the pulp and paper mills.

THIS TREND is spreading rapidly in the chemical industry and is fundamentally sound from an economic standpoint, provided there is a real need for the production. The chemical manufacturer must, of course, demonstrate his ability to supply the consumer at a lower cost than could be obtained either from outside sources or from self-manufacture. Most consumers, on the other hand, prefer not to enter the chemical manufacturing business themselves, although a joint ownership of the subsidiary plant often is a mutually satisfactory answer to the perplexing questions of price and profits.

TO THE CHEMICAL ENGINEER all of these trends are distinctly encouraging. They refute the often repeated charge that there is no longer an opportunity for the smaller producer in the chemical industry. They emphasize again the importance of the individual in building an independent enterprise to use most efficiently all of the technical and material resources at his disposal. Freed of the heavy burden of unproductive costs and possessed of the flexibility that comes from individual initiative and enterprise, the small plant can literally grow up with the industry and territory it serves. In this process the trained and seasoned chemical engineer can profitably become the key man in building new communities of interrelated and interdependent chemical industries.

EDITORIALS

AUGUST, 1931

Reforming the Baleful Byproduct

" . . . Infernal rivers that disgorge
Into the burning lake their baleful streams"

WHATEVER experience Milton may have had in mind, atmospheric and stream pollution by industrial wastes is as old as industry. But the problem has become increasingly important with the expansion of manufacturing activity, particularly in the case of the process industries, which by their very nature may be among the most serious offenders. State legislatures are constantly enacting laws for closer regulation of waste disposal, while modern business demands that every possible waste material be converted into a salable product. Because of this present interest in the subject, *Chem & Met.* will bring together in its September issue a number of authoritative reviews of such recent developments in industrial waste disposal and byproduct recovery as may concern the chemical engineer. The problem will be approached from both the engineering and the legal viewpoints, with emphasis on the accomplishments and requirements of numerous specific industries.

Nitrogen Producers Face Foreign Competition

FACED with a situation where world consumption of nitrogen was equal to approximately 60 per cent of potential capacity, producers of the synthetic product in Europe and of the natural nitrate in Chile met last year, and formulated an agreement regulating production, prices, and export quotas. The agreement covered a period of one year and expired on June 30. For two months prior to that date, negotiations looking toward a renewal of the agreement had been in progress, but without effecting an accord.

On July 15, Germany enacted an emergency decree which placed a prohibitive duty on imports of nitrogenous fertilizers. Interpreting this action as discriminating against nitrate of soda, the Chilean interests withdrew from the conference and it was announced that attempts to continue the international agreement had been abandoned. A later meeting to form a cartel among European producers likewise was unsuccessful. The only official announcement from the conference came from the German Nitrogen Syndicate which stated the following:

> "The negotiations on the prolongation of the International Nitrogen Convention, which have been held in Lucerne, have yielded no results. There was general agreement as to the necessity of avoiding a price war among the negotiators, but the conference broke down owing to the impossibility of reconciling the 'wishes' and the 'possibilities' of the sales question. Agreement was reached among the members of the German, English, and Norwegian groups, but the stumbling block was the demand of the representatives of the Chilean nitrate industry for a considerable increase in their sales quota."

The immediate effect of the breakdown of the conference was seen in protective measures to restrict or regulate imports, taken by Germany, France, Belgium, Poland, and Italy.

From an American standpoint the most important outcome was found in offerings of foreign sulphate of ammonia for shipment to our markets at prices far below those which had been prevailing. Apparently this is tantamount to a declaration that European producers will waive price considerations in order to market surplus stocks in this country. Application for an anti-dumping order already has brought forth strenuous opposition from agricultural interests. But the intent of our anti-dumping regulations is to protect our industries from ruinous foreign price competition such as now appears to threaten domestic producers of nitrogen. If anti-dumping charges are sustained, political or other considerations should not stand in the way of applying, to the full, the remedies which our anti-dumping laws prescribe.

Fusion Welding for Boilers Gains A.S.M.E. Recognition

AFTER more than ten years of consideration, the American Society of Mechanical Engineers has approved a revision of its boiler code which recognizes and makes permissible the use of fusion welding in both power boilers and three classes of unfired pressure vessel. During these ten years many tentative codes were advanced for public discussion. There was a great deal of agitation for early approval of fusion welding, but the boiler code committee refused to be stampeded; and only after it had cooperated for three years with the American Welding Society did it feel in a position to set the seal of its acceptance to a final codification.

Only the briefest summary of the new code is possible here. Welding specifications for power-boiler drums and Class 1 unfired pressure vessels are practically identical. Class 1 vessels are of unlimited application and before approval must be subjected to annealing at a temperature of 1,100 to 1,200 deg. F. for a specified period, sufficient to relieve all stresses. Bending tests and two sorts of tensile tests on plates made during the welding must be passed satisfactorily, and the vessel must be subjected to a hammer test under hydrostatic pressure. Finally, every inch of welded seam, provided the plate is not more than $2\frac{1}{2}$ in. thick (or 3 in. in the case of boilers), must be subjected to X-ray photograph, or to another equivalent, approved method of non-destructive testing.

Unfired vessels falling within the Class 2 and Class 3 groups have specifications somewhat less stringent. A Class 2 vessel is made of plate not over $1\frac{1}{2}$ in. thick; and a Class 3, not over $\frac{5}{8}$ in. Neither may be use for lethal gases or liquids. Among other specifications, the former must not be operated at a temperature in excess of 700 deg. F., nor a pressure over 400 lb., nor with a content of liquid at a temperature of 300 deg. or more. Otherwise, its use is not circumscribed. Class 3 vessels cannot be used at temperatures exceeding 250 deg., nor at pressures above 200 lb. Nor may the temperature

exceed the boiling point at atmospheric pressure of a contained liquid. X-ray tests are not ordinarily required for either of these two lower classes, although the hydrostatic-hammer test is to be carried out, together with bending and tension tests. Annealing for stress relief is required only under certain circumstances with the Class 2 vessel, and is not called for in Class 3.

So far as boiler practice is concerned, the new code is certain to have far-reaching results. Manufacturers have been preparing against the day of A.S.M.E. sanction and several are now ready to meet the requirements. Whether equally far-reaching effects are to be expected in the fusion-welded process vessel field is a moot question. Makers of such equipment have never been under any compulsion to follow A.S.M.E. specifications, nor are they likely to be. Many of the leaders have developed excellent codes of their own, and to many in the process industries the new code will seem unduly stringent where it concerns unfired process vessels. Nevertheless, without regard to the necessity for the stringency, where the code is followed it cannot but increase confidence in welding as a tool of fabrication. It should prove a powerful lever for effecting entrance of welded equipment into places where it has not yet gained admittance. On this score alone, many chemical engineers will consider it a valuable adjunct until such time as a uniform code, devoted strictly to the needs of process vessels, shall have been developed.

Breaking the Boundaries Of Technical Localism

WHILE the trend to general standardization and uniformity may be validly resented by some for its resultant mediocrity and by others because of congenital resistance to change, both objections would be misdirected if applied to any field of scientific venture. It is not only the very nature of scientific effort to establish and work from standards but it is also in the inherent scheme of science to achieve change. Certainly, the results of engineering compromise do not always attain to the most effectual result, as witness the "standard" gear shift; but at least we now know precisely what is meant by an "inch" and precisely what a Western cement maker has done when he reports a strength test on his product.

If domestic conditions have thus made it essential that engineering and manufacturing circles know what they are talking about, through such agencies as the A.S.T.M. and the American Standards Association, it has become equally apparent that the whole world is moving in the same direction. Whatever one's opinion on the benefits of foreign commerce, it shows increasing vitality everywhere. And because it must be based more and more on tested, standard products, the methods and measures employed will demand general unification.

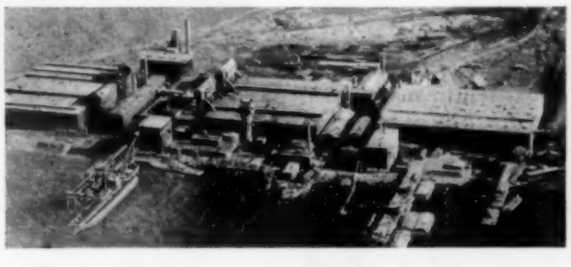
A notable achievement in this direction is the permanent International Standards Association at Basel, of which the American Standards Association is one of 18 members. A further step is now promised by the congress of the International Society for Testing Materials early in September at Zürich. Various European nations, with their own house in fairly good order, have initiated this meeting, for which they have gained the cooperation of the American Society for Testing Materials in the form of delegates and papers. What is especially encouraging about this participation in broader standardization is the part that the American manufacturer, through his technical forces, can play in a rational development that involves many possible advantages without any embarrassing obligations.

Too Many Cooks for The Patent Broth

PATENT appeals in our courts are too complicated, too likely to result in long delays, great expense, and even in what often appears to be gross injustice. This is chiefly the consequence of the simultaneous jurisdiction of ten separate federal circuit courts, each of which is final within its own jurisdiction. Ten different decisions are conceivable in a single case and there is no certainty of coordination of the decisions in the Supreme Court of the United States.

We should not and cannot expect satisfactory operation from such a system. Not only are the circuit courts badly congested but it is unreasonable to ask of their judges the training, temperament, and experience required in highly technical patent matters. Even if these things were possible of achievement, the duplication of effort indulged in by ten such paragons would be a woefully uneconomic proceeding.

A proposal made by Edwin J. Prindle, and intended to correct this bad situation, has received the enthusiastic backing of important engineering societies. Briefly, Mr. Prindle suggests the establishment of a single Court of Patent Appeals to which cases could be taken from all federal district courts. Decisions of this court would be final except where there were features so unusual as to justify final action by the Supreme Court itself. Thus at one stroke, needed relief would be given the circuit courts, while at the same time many of the difficulties that beset the patent litigator would be eliminated, once and for all. There is no reason why one court eminently versed in patent art and technicalities could not be assembled. There is every reason why Congress should consider the suggestion favorably during its session this coming winter.



New Efficiency Record

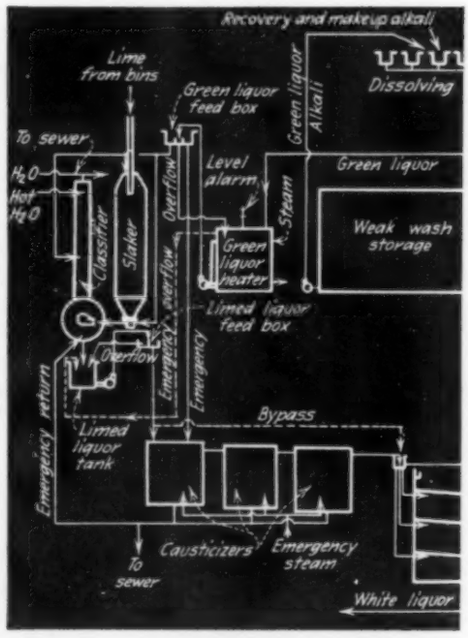
The plant in which the spent digester liquors from International's pulp and paper mill in Florida are recausticized and reprocessed for further use in the digesters is of the continuous, mechanically operated type. Results obtained consistently for the past few months appear to be better than the best produced heretofore with continuous plants of somewhat similar design

WHEN the International Paper Co., in the early part of 1930, consolidated its Southern kraft mills under the management of a new corporation, known as Southern Kraft Corp., there were welded together in a closer union five mills, one each at Moss Point, Miss.; Camden, Ark.; and Mobile, Ala.; and two at Bastrop, La. Shortly after this consolidation of International's kraft interest in the South, the new corporation started the design and construction of a mill at Panama City, Fla., located on the sea coast and provided with a virtually inexhaustible supply of quickly growing slash pine in the adjoining swamp land.

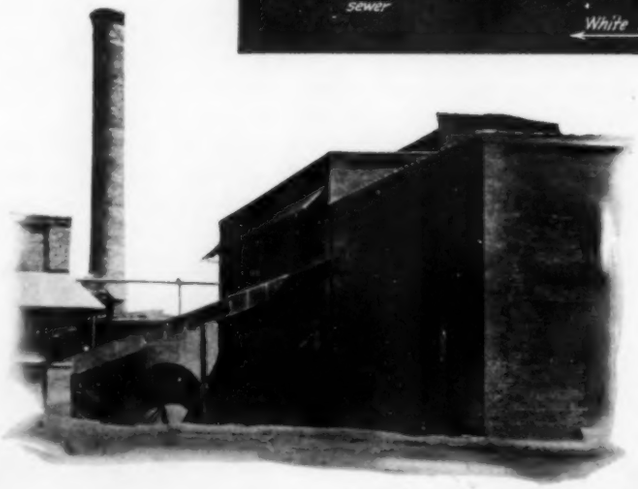
In February, 1931, this new project began operation and increased the daily capacity of the corporation to 1,250 tons of kraft pulp and the extent of its scientifically reforested timber land to 1,250,000 acres. The extensive experience of the staffs of International Paper Co. and its subsidiary, Southern Kraft Corp., in the technique of sulphate pulp manufacture, coupled with a policy to use only the most modern machinery and advanced processing methods, has resulted in the design of a 300-ton plant which is rightly regarded as the last word in kraft practice.

The chemical-reclaiming plant where the spent digester liquors are recausticized and reprocessed for further use in the digesters is of the continuous, mechanically operated type and as such represents a distinct departure from past practice at the mills of this company. Results obtained consistently for the last two or three months are, of course, without a parallel in recausticizing plants of the intermittent type and appear to be better than the best obtained heretofore with continuous plants of somewhat similar design.

By reference to a few critical data the efficient level upon which operation has been consistently maintained for several months is clearly reflected. The system has demonstrated its ability to produce easily the quantity of digestion liquor required to produce 310 tons of kraft board per day, with a soda loss corresponding to only 0.67 lb. of sodium sulphate per ton of pulp and a consumption of only 126.5 lb. of new burned lime per ton



Flow Sheet for Caustic Recovery in the Panama City (Fla.) Plant of the Southern Kraft Corp.

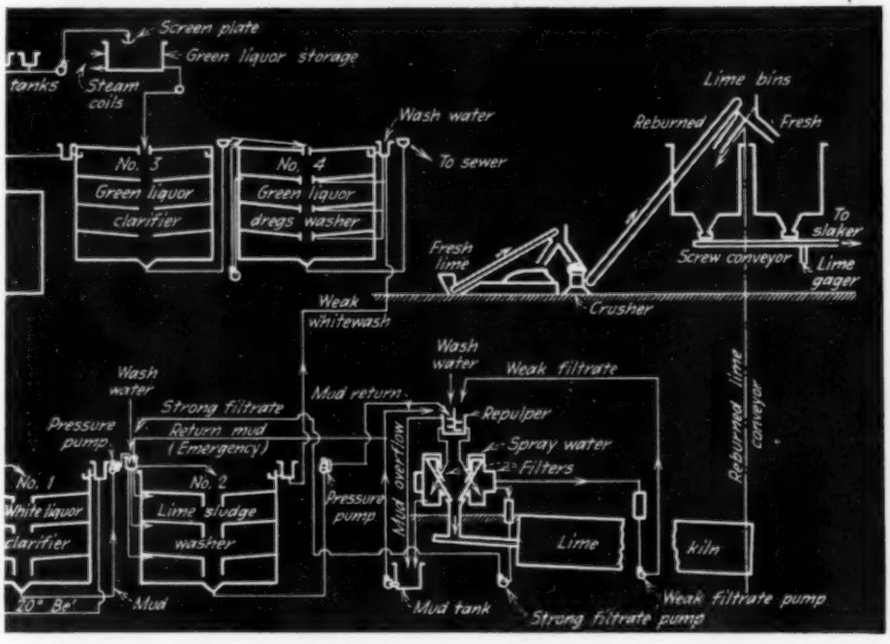


Recausticizing Building With New Lime Unloading Platform and Covered Conveyor at Left

Established

In Chemical Reclaiming

▼ ▼ ▼



of pulp. The clear digestion, or white liquor, has a temperature of 185 deg. F., a strength of 20-23 deg. Bé., and a causticity of 85.2 per cent and contains, on the average, 175 grams per liter total alkali, consisting of 115.2 grams per liter NaOH, 31.8 grams per liter Na_2CO_3 and 28.1 grams per liter Na_2S. A small quantity of soda, equivalent only to 1.37 per cent Na_2SO_4, is contained in the filtered lime mud, but all of this is returned to the system, since the lime cake is reburned in a rotary kiln and subsequently reused.

The design of this plant was influenced by a number of factors, some economic, some technical, and others of an operating nature. Experience with the intermittent type of causticizing system at other International mills indicated that a similar installation at Panama City should produce a satisfactory white liquor with a loss of 14 lb. sodium sulphate per ton of pulp, and a consumption of 200 lb. of new burned lime per ton of pulp. A continuous plant of equivalent capacity was known to cost slightly more than an intermittent plant, and to be attractive commercially would have to show such a saving in salt cake, lime, labor, and steam as to pay an attractive profit on the additional capital required.

Foundations having been laid and building designs completed for an intermittent plant, the continuous plant of the same capacity would have to be contained in a building of the size specified. Furthermore, the mechanically operated equipment would have to be ready for installation at a stated and early date, as the production schedule could tolerate no postponement.

The facility with which the former intermittent plants could be maintained in operation, even during repairs to equipment, made it essential that the continuous plant be arranged for uninterrupted performance by providing for interchangeability of parts in the case of major equipment units, duplicate sets of interchangeable auxiliaries wherever possible, and finally provision for temporarily cutting any unit out of service by an elaborate system of bypasses.

Simplicity of chemical control dictated the separate storage and feeding of new and reburned lime, the production of a single, white liquor from a single source, and the collection of all weak wash solutions at a single point. And good engineering practice required, first, the conservation of heat by covering and insulating all tanks and pipe lines and, second, the utilization, wherever possible, of gravity for the transfer of solids, solutions, and sludges.

Governed by the above considerations and guided by the arrangement used at other continuous, recausticizing plants, the accompanying flow sheet was adopted. It will be seen that each of three materials entering the system

—molten sodium sulphide, burned lime, and water—pass through a definite and separate cycle, undergo chemical change, and eventually leave the system as component parts of the two finished products—white liquor and washed dregs—or else remain in the system as recycled products, such as precipitated calcium carbonate or weak wash solution. The flow sheet follows the conventional lines of a series of interconnected unit operations, common to chemical engineering practice, and the discussion of it may therefore most conveniently be subdivided along functional and operational lines.

The soda-bearing liquid removed in the diffusers from the digested stock is concentrated to 23 deg. Bé. in Swenson evaporators, further concentrated in Murray disk evaporators, burned to an ash in rotary incinerators, and finally melted in caldwell furnaces. The molten product, chiefly sodium sulphide, from the furnaces is dissolved in tanks, using the weak wash solution produced in the recausticizing plant. The resulting soda-bearing solution is the green liquor to be clarified and then recausticized to form white or digestion liquor and is stored in a tank, heated by submerged steam coils.

Raw green liquor contains a number of insoluble impurities such as unburned carbon, iron sulphides, and fragments of the refractory furnace and incinerator linings. The presence of these impurities, particularly iron sulphides, retards the rate of recausticizing, reduces the settling and filtration rates of the lime mud, renders the washing of the mud to free it of alkali more difficult, and finally interferes with the reburning of the lime in the kiln.

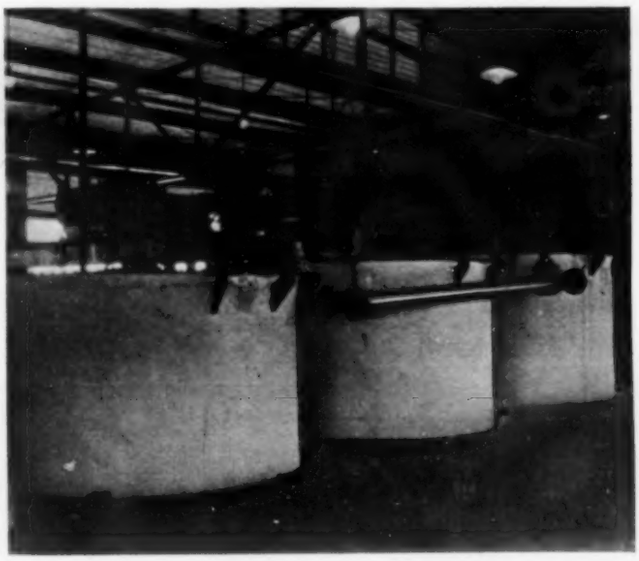
These dregs, as the impurities are called, are removed by passing the raw green liquor through a four-compartment Dorr tray thickener, installed in a covered and insulated steel tank. The clarified green liquor is collected in overflow boxes connected to each compartment and is stored in a heated tank, 9 ft. in diameter by 10 ft. deep, preparatory to the next operation; recausticizing with milk of lime.

Table I—Operating Results

General Over-all Plant Results (Six Weeks' Daily Average)	
Daily production kraft pulp, tons per 24 hr	310.8
Green liquor production, cu.ft. per ton pulp	87.2
Availability of reburned lime, per cent	79.9
Total lime required, lb. per ton pulp	474.3
Make up lime required, lb. per ton pulp	126.5
Loss of salt cake in system, lb. per ton pulp	0.676
Efficiency of reuse of lime, per cent	73.3
Green Liquor Handling	
Density of clarified green liquor, deg. Bé	20
Temperature of clarified green liquor, deg. F	180
Equivalent salt cake in washed dregs to sewer, lb. ton pulp	0.676
Lime Slaking	
Lime slaked, lb. per ton pulp	474.3
Washed grit rejected, lb. per day	1,580.0
Dilution (liquid to solid) slaker discharge, ratio	3.63/1
Dilution (liquid to solid) classifier overflow, ratio	6.35/1
Recausticizing	
Detention period during causticizing, hours	1.74
Temperature during causticizing, deg. F	200–210
Causticity or conversion after causticizing, per cent	84.0
White Liquor Production	
Temperature of clarified white liquor, deg. F	185
Causticity of clarified white liquor, per cent	85.2
Density of clarified white liquor, deg. Bé	20–22
Dilution (liquid to solid) thickened lime mud, ratio	1.5/1
Lime Mud, Washing and Filtration	
Moisture content filter cake, per cent	51.5
Equivalent sodium sulphate content washed cake, per cent	1.37
Mud washing efficiency secured, per cent	99.3

Dregs settled in the green liquor clarifier are removed as a dilute sludge by a diaphragm pump and are washed practically free of dissolved sodium salts in a four-compartment washing thickener. Washed dregs are removed by a diaphragm pump and flushed into the sewer. Fresh water is used for washing and the weak soda liquor resulting from its use is collected in a weak-wash solution storage tank.

New and reburned lime are stored in individual bins, each equipped with an automatic gate feeder. Either new burned lime, reburned lime, or any desired mixture of the two may be fed continuously in measured quantities to a Kilby rotary lime slaker.



Interior of Causticizing Building Showing the Three Series-Connected Dorr Causticizers in Which the Reaction Takes Place

Clarified green liquor is continuously circulated by a centrifugal pump through an elevated weir box, close to the lime slaker, so that, of the green liquor subsequently to be causticized, any desired quantity may be diverted into the slaker for hydrating the burned lime and the remainder used to dilute the thick paste of milk of lime issuing from the slaker.

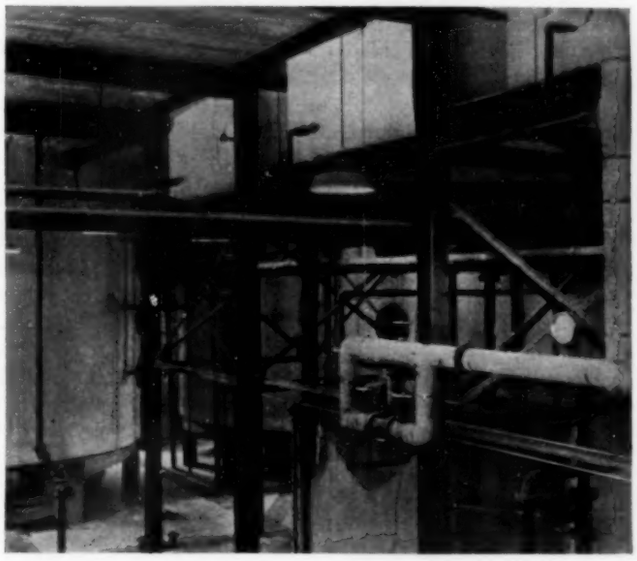
The diluted milk of lime contains appreciable quantities of gritty substances such as sand and unburned core. These are removed by passing the suspension through a Dorr bowl classifier, 2 ft. 3 in. wide, 21 ft. 4 in. long, equipped with a 6 ft. diameter bowl. Gritty solids settle in the classifier, are raked through a washing spray, and are rejected to the sewer. The grit-free suspension of limed liquor overflows into a surge tank and is circulated by a small centrifugal pump through a constant-head feed box which regulates the rate of flow to the causticizers.

The limed liquor enters the first of a series of three Dorr causticizers, each 9 ft. in diameter × 10 ft. deep, connected by short pipe lines and installed on slightly different elevations so that the pulp may flow through them successively by gravity. The volume provided gives a detention of a little less than two hours during the causticizing reaction, and a temperature close to the boiling point of water is maintained by the use of live steam.

On leaving the last of the three causticizers the pulp consists of hot digestion liquor, holding in suspension a finely divided precipitate of calcium carbonate. The

removal of this precipitate and the consequent clarification of the white or digestion liquor is effected in a three-compartment thickener. Clear overflow solution is collected in boxes, connected to each compartment, and pumped to storage tanks near the chip digesters. The precipitated calcium carbonate, thickened to a sludge of high density, is removed from the bottom of the thickener tank by a diaphragm pump and prepared for washing.

After the lime sludge from the white liquor clarifier is diluted with fresh water it is fed to a second three-



Thickeners Used for Green and White Liquor Clarification and Mud Washing; Causticizers in Upper Right Corner

compartment thickener. The weak solution collected as an overflow product from this unit is pumped to the weak-wash storage tank in which also is stored the weak solution originating in the dregs-washing step. The washed lime sludge, considerably impoverished in dissolved soda salts, is removed by a diaphragm pump and prepared for a final washing and dewatering on vacuum filters.

In a steel tank equipped with a Nettco agitator of the paddle type the lime sludge is first repulped. Into this tank also flow a small quantity of fresh water and a somewhat greater quantity of very weak filtrate, obtained during the washing of the lime cake on the filters.

The resulting dilute lime pulp is fed by gravity to four Dorrco vacuum filters, provided with water sprays for washing the cake and arranged so that excess feed pulp may overflow to a surge tank and be returned to the repulping tank by a centrifugal pump. The first, relatively strong, filtrate, formed during cake formation and drying, as well as fresh water, is used for washing purposes in the thickener used for washing lime mud or may be diverted to the weak-wash storage tank. The second filtrate, considerably weaker than the first, is formed during the application of water sprays upon the cake and, as stated in the preceding paragraph, is used for repulping the lime sludge prior to filtration.

The washed and dewatered lime cake is discharged from the filters into an inclosed screw conveyor which feeds it into an Allis-Chalmers rotary lime kiln.

Reburned lime is discharged from the rotary kiln onto a drag flight conveyor which delivers it to the reburned-lime storage bin, constructed of steel. A cross-conveyor is provided to convey the reburned lime to a storage floor in the event that the bin is filled.

New burned lime for making up losses in the system is unloaded from cars into a hopper feeding a flight conveyor. The conveyor discharges into either one or the other of two spouts. One spout is rigidly fixed and feeds a Sturtevant rotary lime crusher which reduces the lime from 4-in. lumps to $\frac{3}{4}$ in., while the other spout is arranged to swing horizontally so as to distribute uncrushed lime over the storage floor. Crushed lime passes into the boot of an elevator under the crusher and is fed either into a new lime storage bin, constructed of steel, or into the reburned lime hopper of the same size.

Into the base of each of the two storage bins there is fitted a short, conical adapter, conducting the lime into two Allis-Chalmers automatic feeders, of the oscillating gate type. These feeders discharge the lime into a short screw conveyor which introduces it into the rotary slaker, thus completing the cyclic path of the lime through the plant.

Reburned and new lime will be piled on the storage floor only in case of emergency and when the lime bins are completely filled. As required, the lime so stored will be moved by wheelbarrow either into the feed hopper of the crusher, in the case of new lump lime, or into the boot of the elevator under the crusher, in the case of reburned lime. The arrangement at the top of the conveyor permits the product to be discharged into either one or the other of the two storage bins according to its point of origin.

The recausticizing building is 56 ft. wide, 82 ft. long, and measures 34 ft. from the floor level to the lower chords of the steel-roof trusses. It is of steel-frame construction with brick walls, tile roof, and surmounted by a ventilating monitor. Upon the ground level are located the foundations for the four thickeners, the solution storage and heating tanks, lime crusher, feeders, slaker, bowl classifier, filter auxiliaries, and miscellaneous solution pumps. Vacuum filters are installed upon a floor above, and lime bins, causticizers and sludge pumps are mounted well above the ground level, in order to give gravity flow of lime into the feeders and gravity flow of causticized pulp and thickened lime sludge into the thickeners.

Interchangeability of parts used in the major equip-

Table II—Connected Horsepower of Motors

Drag conveyor, unloading new lime	5
Rotary, lime crusher	10
Bucket elevator, crushed lime to bin	3
Bucket elevator, reburned lime to bin	5
Lime feeders and screw conveyor	5
Rotary lime slaker	10
Bowl classifier	5
Thickener, green liquor clarification	2
Diaphragm sludge pump for above	1½
Thickener, dregs washing	2
Diaphragm sludge pump for above	1½
Causticizers (3)	10
Thickener, white-liquor clarification	2
Diaphragm sludge pump for above	3
Thickener, lime mud washing	2
Diaphragm sludge pump for above	3
Diaphragm sludge pump, spare	3
Repulping agitator, filter feed	1
Continuous vacuum filters (4)	12
Vacuum pumps (2)	30
Filtrate pumps (2)	6
Centrifugal pump, filter overflow recirculation	3
Miscellaneous centrifugal pumps, liquor circulation (4)	30
Total	155

ment units is assured by having all thickeners, causticizers, filters, and feeders of the same size. For the same reason, the number of different sizes and types of motors, speed reducers, solution pumps, and sludge pumps has been reduced to a minimum.

By means of a carefully thought-out series of interconnecting bypasses, any lime bin, feeder, causticizer, thickener, sludge pump, or filter may temporarily be removed from service without interrupting the operation of the plant. Drainage connections are provided for the rapid unloading of all tanks, and pipe lines handling sludge or pulps are arranged so that solid obstructions may easily be cleared by water jets or by rodding out through blind flanges at the ends of the lines.

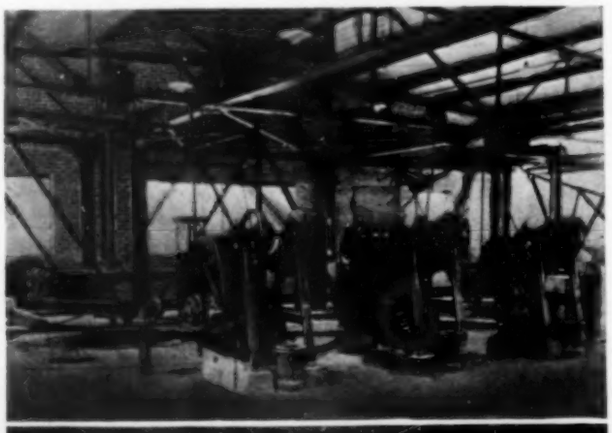
All machinery is equipped with individual motor-drive units operating on 440-volt, 3-phase, 60-cycle current. Every electrical motor is equipped with anti-friction bearings, and where these motors are used to drive centrifugal pumps, lime filters, or other equipment subject to flooding or spraying in washing down the plant, they are of the totally inclosed, fan-cooled type.

A well-arranged laboratory is staffed to take care of routine analyses at different stations in the recausticizing system. On the basis of the results of these analyses, close chemical control is maintained over each operation, with the result that fluctuations in the composition of the green and white liquors and in the percentage recovery of lime and soda are consistently held within narrow limits.

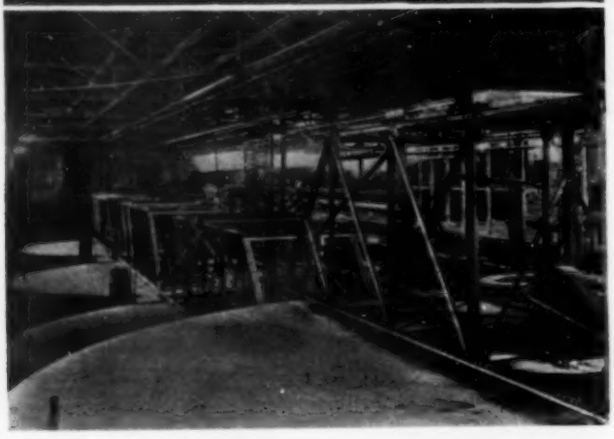
At the beginning of this article the statement was made that this recausticizing plant had established a record for efficient operation, eclipsing results secured at other plants of both the intermittent and continuous type, based on the extremely small quantity of new lime and salt cake required. While the extent to which lime may be reused and the extent to which the loss of soda may be avoided is a true measure of plant efficiency, other supplementary data are available to show that this high level of general efficiency is a cumulative result of careful, efficient operation at each individual point in the process cycle.

The operating record is shown in tabular form. The table has been subdivided to cover in sequence the data obtained at the different stages of the system in order to follow the chronology of the arrangement used in the diagrammatic flow sheet and the accompanying comments.

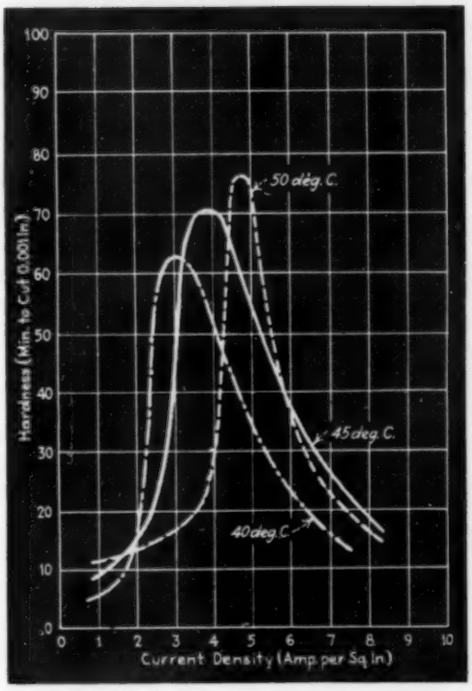
The total connected horsepower of 155, of course, has only slight relation to average power load, first, because a considerable amount of the lime-handling and crushing equipment operates only a few hours each day; second, because in most cases a spare pump and feeder is provided at each station; and, third, because the rated output of a given motor is seldom fully utilized, except in overcoming the initial inertia of equipment being placed in operation. For these and other reasons it is doubtful whether the average power load over a full 24-hr. period would exceed 67-75 hp.



Three Dorrco Diaphragm Pressure Pumps, Handling Lime Mud Settled in Thickeners



Thickeners in the Chemical Reclaiming Plant at Panama City



Influence of Current Density and Temperature on Hardness

"The surface of hard chromium plating has not been scratched yet," has been suggested as a slogan for thick deposits of chromium, as it aptly points out not only the intrinsic hardness of chromium but also the undeveloped possibilities in this virgin field of electrodeposition

▼

Thick Chromium Plate

Through Judicious

Operating Control

By R. J. PIERSOL

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IN ADDITION to abrasive hardness, thick deposits of chromium possess two other important characteristics: resistance to corrosion and resistance to high temperatures. The corrosion resistance to acids and other oxidizing reagents is associated closely with the dual nature of chromium, which may exist either in the active or the passive state. When in the active state chromium is attacked rapidly. Therefore it is necessary to avoid conditions causing the activity of chromium, the most common of which is the free chlorine ions of hydrochloric acid. Fortunately, under normal conditions the atmosphere itself contains sufficient oxygen to assure the passivity of chromium. In this passive state, the position of chromium in the Volta electromotive series is shifted toward the noble metals. Therefore the very oxidizing reagents, such as nitric acid, chromic acid, and atmospheric oxygen, which corrode iron, copper, and nickel serve as a protection in that they maintain the surface of chromium in a passive state.

But in the use of thick deposits of chromium for surface protection against corrosion not only is it necessary for the deposit of chromium itself to withstand the oxidizing reagents but it is of equal importance that the plate form an impervious covering so that the foundation metal will not be corroded beneath the deposit of chromium. In other words, it is essential that the chromium be free from excessive porosity and also from fissures. The porosity of chromium is associated closely with the percentage of hydrogen occluded in the chromium during the plating; while the fissures, extending through the depth of the deposit, are due primarily to excessive lateral stresses set up at the time of plating. Therefore in the case of corrosion protection it is desirable to so control bath variables as to obtain a high degree of density, or non-porosity, of deposit coupled with a minimum of internal stresses.

When thick deposits of chromium are desired, it has become established practice to plate the chromium directly on the foundation metal. There are two reasons for this: First, the adhesion of plated chromium is far stronger than any other plated metal; secondly, where wear resistance is desired, not only is it essential to have a hard foundation metal but also a cushion of relatively soft copper or nickel must be avoided.

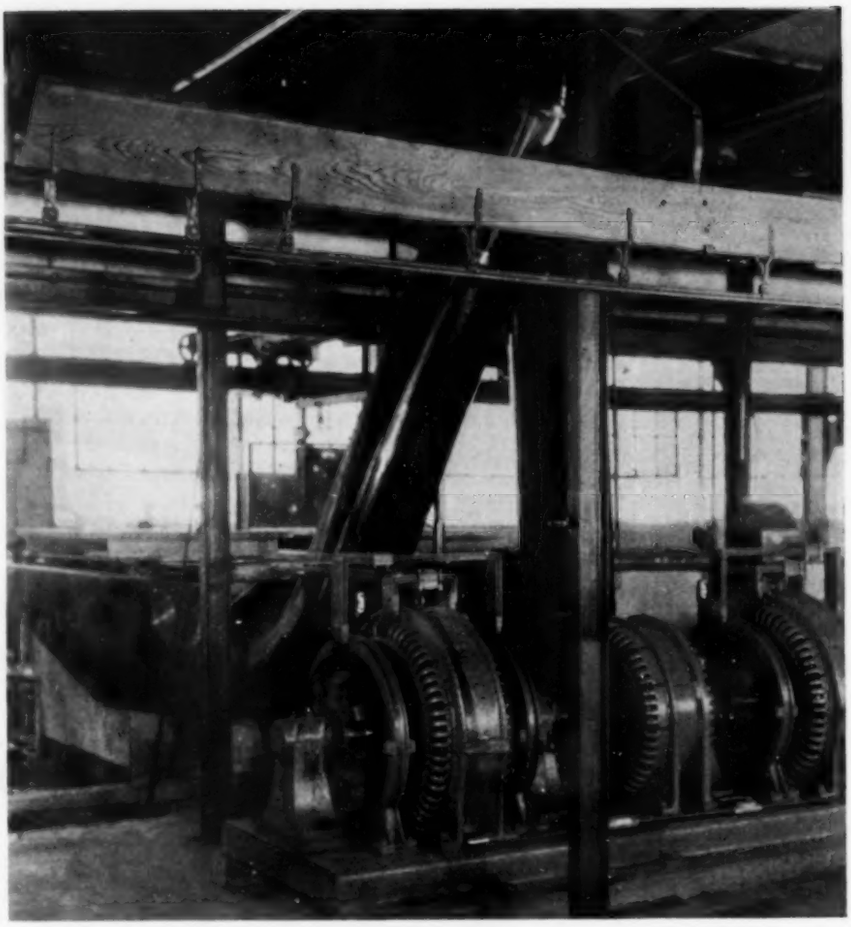
Thick deposits of chromium have remarkable characteristics at elevated temperatures. These are due partially to its high melting point—approximately 1,560 deg. C.—and also to its high temperature of initial oxidation, which is slightly over 600 deg. C. Even at this temperature an oxide film of the thickness of the wave length of visible light (about 5×10^{-5} in.), as shown by interference color, is formed which is even more refractory to oxidation than the chromium itself. Chromium-plated floodlights have been operated at a temperature of 300 deg. C. for five years without any appreciable deterioration in the coefficient of reflection, which is approximately 65 per cent. Chromium-plated bells have been used in welding seamless tubes under an oxidizing flame in which the weld passes momentarily against the plate of chromium at a surface temperature of about 1,600 deg. C., which is slightly in excess of the melting point of chromium. There is no tendency for sticking, although, if an iron bell is used, the weld fuses to it.

In order to understand the influence of the bath

variables on the characteristics of thick deposits of chromium it is necessary to consider briefly the nature of electrodeposition. Any electroplate is crystalline in character. The crystal arrangement determines the hardness of a substance. This is illustrated vividly by carbon, one crystalline form of which is graphite, one of the softest substances; while another form, diamond, is the hardest known substance.

Since the discharge potential of chromium ions is higher than that of hydrogen ions, all chromium plate is impregnated with hydrogen at the time of deposition to a degree dependent on the operating conditions.

A typical chromium-plating solution consists of 250 grams of chromic acid and 2.5 grams of sulphuric acid per liter. Theory shows that such a plating electrotype is unique in that there are no free chromium ions dissociated except during electrolysis, due to the fact that the chromium ions are formed in a secondary reaction between partially reduced chromic acid and sulphuric acid, in the transient form of ionized chromic sulphate. But even during electrolysis the free chromic ions have only a momentary life, as they immediately combine with chromic acid to form chromium dichromate. Therefore in chromium plating there exists the paradoxical condition that the single potential of the chromium ion decreases rather than increases with the increase of current density, due to the fact that the relative number of chromium ions is increased rather than depleted with an increase of current density. There is a logarithmic relationship between the electrochemical efficiency of chromium and current density.



Heart of a Hard Chromium Plating Unit Is the Motor-Generation Equipment; A Double Unit of Motor Generator, Chromium Tank, and Exhaust System

Since the percentage of hydrogen occluded affects the crystal formation of chromium, it would be expected that such factors as current density and temperature would influence the hardness of the deposited plate. The enormous variation in hardness as affected by these two operating factors is shown in an accompanying diagram. Also any bath variant which influences the relative rate of formation of free chromic ions likewise affects the hardness of the deposit. These factors include the concentration of chromic acid, the amount of sulphate, the percentage of trivalent chromium, and added ingredients, such as iron. Each one of these variables has been investigated separately, keeping the other five constant. It is found that they are interrelated, so that the change of one variable necessitates the change of one or more of the others to regain the condition of maximum hardness.

Not only do these six variables influence the hardness of chromium but they affect its porosity and magnitude of internal stresses as well. Therefore where the combination of hardness, density, and ductility is desired, it requires considerable experimentation to ascertain the optimum value of each of the variables.

Naturally the essential qualities desired in a particular plate depend on the application in question. Therefore the desired fixed constants for the bath variables should be standardized by a chromium engineer and adhered to religiously by the operator. Anyone who recommends arbitrarily certain over-all values for these variables, without knowledge of the application, thereby indicates a lack of understanding of hard plating.

When these constants are established for some given application, such as a certain Bakelite mold, the average current density may be maintained by an ammeter. But the distribution of current density is of even more importance than the duplication of the average value of the current density. Therefore with the exception of a few articles, such as flat plates or round rolls, where the contour naturally permits uniform current distribution, it is standard practice to use shaped anodes.

The tendency toward non-uniform thickness of deposit is great, due to the fact that the current efficiency increases rapidly, as shown previously, with the current density; while the cathode polarization remains practically constant with current density. So an ingenious anode designer is essential to successful hard plating. Where the same articles are plated on a production basis, it is remarkable how uniform a thickness distribution may be obtained by a properly shaped anode. Where a narrow, bright plating range is used, uniformity of thickness may be gaged by uniformity of luster.

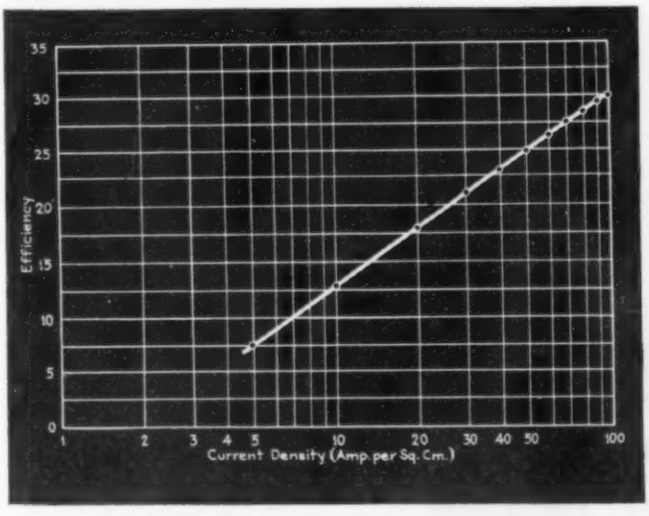
A thermostatic control should be used to maintain the temperature of the bath to within a range of 1 deg. C. Where large surfaces are plated at high current density, circulation of the solution through a central storage tank is recommended as a means of keeping the temperature of the solution down to a desired point. Also circulation

permits continuous filtration, which is essential to the smoothness of the deposit.

The percentage of chromic acid and sulphate radical each should be maintained within 5 per cent of the predetermined value, based on chemical analyses at fixed intervals. The length of this time interval is dependent altogether on that required to keep within the permissible variation.

If a lead-lined tank and lead anodes are used exclusively the quantity of trivalent chromium can be maintained easily to a maximum of 3 grams per liter. Likewise it is essential that no wood, or other material which may be oxidized by chromic acid, come in contact with the solution. This is because chromic acid is reduced to trivalent chromium to the same degree as it oxidizes any foreign material.

The voluntary addition of iron chromate, or the accidental accumulation of iron from either iron tanks or iron anodes, usually is associated with a higher equilibrium value of trivalent chromium in the solution. Up to about 10 grams per liter of both iron and trivalent chromium, a hard, bright, dense coat of chromium may be deposited at relatively low current densities (about 150 amp. per sq.ft.). But the resistance of such a bath is high—approximately twice the normal value of 1.5 ohms per cm^3. Since the iron accumulates, rather than assuming an equilibrium value, it is recommended, especially when close technical supervision is impossible, to eliminate iron and high trivalent chromium as bath variables by the exclusive use of lead instead of iron for tank lining and anodes. This is because the same type of plate may be obtained by increasing the temperature



Influence of Current Density on Efficiency

from 45 deg. C. to 60 deg. C. and the current density from 150 amp. to a range between 400 and 600 amp. per sq.ft. The increase in current density gives approximately five times the rate of deposit; that is, the thickness per hour is increased from less than 0.0005 to 0.002 in.

In the case of almost all articles to be plated, requirements are such as to necessitate a surface which has been cold worked; that is, cold drawn, cold rolled, machined, ground, or polished. If it were required to plate an exceptional article, which had been hot finished, naturally the first operation would be to remove the fire scale. This may be done by pickling, although a mechanical process such as sandblasting is preferable, in that the pickling may either embrittle the surface or it may form dead spots, with resultant poor adhesion of the chromium plate.

A bath of fish oil, or some similar solvent, for heavy greases is the first step in plating an ordinary article. Obviously this bath should be suited to the cutting or grinding compound used in the finishing operation. And the second step is a rinse to remove the solvent. The third is an electric cleaner, which may be either acid or alkaline. It is desirable to use a reversing switch, so that cathodic cleaning may be followed by anodic cleaning. The temperature of the cleaner, the current density, and the length of time of cleaning depend on the metal in question. In a general way it may be stated that there should be thorough cleaning without excessive pitting or tendency toward tarnishing.

The fourth operation is a rinse following the electric cleaner. In all rinsing operations, either a spray should be used or sufficient circulation of fresh water to maintain a clean rinse.

The chromium-plating operation should follow instantly, in order to avoid surface oxidation. With fixed operative constants, the thickness of the deposit is a direct function of the time of plating. Therefore it is desirable to set an automatic signal, either bell or red light, to indicate completion of the plating operation.

Exhaust ducts along the sides of the tank must be used in order to remove the fumes. Any fume preventive, such as a film of kerosene on the surface of the electrolyte, not only is worthless but in addition is likely to contaminate the article as it is placed in the solution to be plated.

A cold rinse immediately follows the plating operation, and the final step is a hot rinse, in order to cause immediate drying of the chromium-plated surface.

Where thick plates of chromium are deposited, considerable grief has been due to peeling. This is especially true when the article is subjected to severe stresses such as in the case of a set of rolls for cold-rolling finished sheet. By proper control of operating variables it is possible to plate extremely adherent deposits of chromium possessing low internal stresses. Therefore chromium may be plated to any desired thickness.

The cracking of the chromium plate is due to the same causes as peeling. In the case of cracking, however, there usually is better adhesion to the foundation metal, but less ductility than when peeling occurs.

In plating certain metals, such as high-carbon steels, Nichrome, aluminum, and other metals requiring a high initial voltage, poor adhesion is almost universal. In such cases the obvious solution is to substitute a foundation metal which is suitable for plating. The surface of the metal should be free from pores and capable of taking a high luster finish. The foundation metal should be sufficiently hard to resist body stresses. It should not be brittle, as there is an added hydrogen embrittlement due to the copious liberation of hydrogen during plating.

When chromium is heated to over 600 deg. C., at which temperature a discoloration of the surface occurs, and is then cooled to normal temperature, there is a permanent loss of hardness of the metal. Therefore it is not satisfactory for abrasive resistance where there is intermittent heating. On the other hand, the abrasive resistance of chromium is excellent at high temperatures as compared with heat-resisting alloys.

At relatively high current density and temperature, a 5,000-amp. motor generator will plate at one time a total surface area of about 10 sq.ft. at the rate of 0.002 in. per hour. This capacity makes a convenient sized unit

for the average production work. The approximate initial cost of such a unit is $10,000. This is divided about equally between generator, tank, and miscellaneous equipment.

For production plating the operating cost usually is from two to four times the electric power cost, depending largely on the degree to which automatic equipment is used. A good motor-generator set has 60 per cent efficiency. Therefore 5,000 amp. at 6 volts would consume 400 kw.-hr. for an 8-hour day. At a rate of 3c. per kw.-hr., the power cost would be $12 per day, and the total operating cost would range between $25 and $50. In other words, the average operating cost would be approximately 25c. per sq.ft. of surface for a chromium plate 0.001 in. thick.

Technical requirements are exacting in getting a unit on a production basis. After all the standards are established, it is preferable to have the operation carried on by a man of mechanical bent of mind, who is conscientious in following instructions. It is desirable that the operator should have no control over the chromium bath or the cleaning bath. These should be maintained to consistency by an analyst not responsible to the plating operator.

In starting a unit the advisory services of a competent chromium engineer are desirable in assisting the department to get off on the right foot, but his services should be advisory only, for the responsibility for successful production has to be placed with a permanent production engineer. Where an ordinary article is to be plated the company should be able to dispense with advisory services entirely by the end of two months' operation.

Although the initial investment and the operating cost of a hard-plating unit may seem high, nevertheless if a production article warrants either wear or corrosion protection, the only economical and satisfactory procedure is to install the unit as a part of the plant operation rather than farm the item out to a custom plant.

Bakelite molds are an unusually economical application for chromium plating. Before the use of chromium it was necessary to resurface the mold previous to each imprint for high luster finish. With a chromium plated mold it is possible to obtain several thousand impressions. A set of molds, plated to 0.005 in. thickness, have a record of 25,000 impressions for a molded silent timing gear used in a certain manufacturer's automobile.

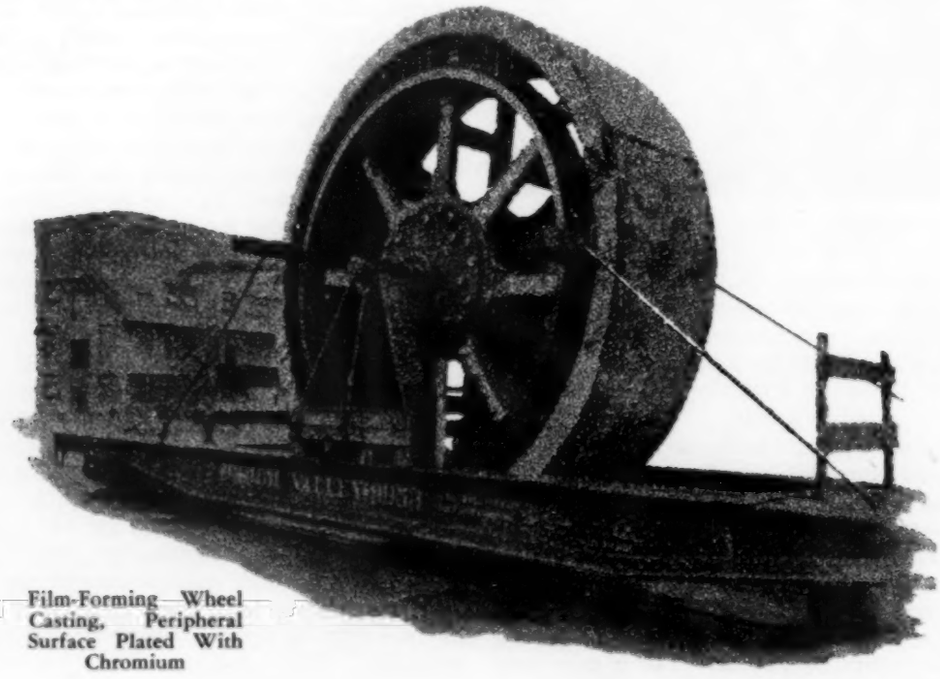
High temperatures and pressures are used for the cracking of heavier oils to form gasoline. Two years ago in California 60 stills, 10 ft. in diameter by 40 ft. high, made from sheet iron 2 in. thick, were chromium plated. Up to the present time there is no indication of corrosion, although the normal rate of corrosion of an unplated still is 0.5 in. per year. The magnitude of such a plating operation is shown by the fact that it required about 25,000 gal. of chromium-plating solution and 10 days to plate each tank.

Calender rolls used in making paper give from eight to ten times normal surface wear when chromium plated. Tuber screws, used for pressing molded material into molds at a relatively high pressure, give a surprising increase in life. Not only is the coefficient low between the screw and the molded material but in addition there is no tendency for the material to stick to the screw.

The plate-glass industry has had excellent success with the chromium-plated lehr rolls for annealing furnaces. Rolls are up to 10 in. in diameter and 20 ft. in length. An alloy roll for this purpose costs about $250, while a seamless tube roll, chromium plated, costs about $50. One company estimates a saving of a quarter of a million dollars due to its hard-plating unit. Under annealing furnace conditions, the loss of chromium is about 0.001 in. per year. The standardized thickness of plate is 0.007 in., which is deposited in 10 hours.

In clay-mixing machines abrasion is rapid. Chromium is far more resistant to the wear than would be expected from hardness comparison, apparently because the gritty particles in the clay slip over the surface of the chromium without abrasion while they cut into the surface of the iron. In the case of propellers, it takes five times the length of time to wear through chromium, 0.002 in. in thickness, that it did to wear 0.5 in. in depth in the unplated cast-iron propellers.

Space does not permit even the listing of the present uses of thick deposits of chromium. Since hydrochloric acid is the only common reagent that attacks chromium, the chemical industry is finding an increasing number of applications based on the corrosion resistance of chromium.



Film-Forming Wheel Casting, Peripheral Surface Plated With Chromium

Electroplating Tungsten From Alkaline Solution

By COLIN G. FINK

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AND

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THE problem which we set out to solve was that of developing a process for the electrodeposition of metallic tungsten from aqueous solutions which would be adaptable for use on a commercial scale. Electroplated metallic coatings usually are desired because of the decorative value of the plated metal or because of an increased resistance to corrosion.

A coating similar to electroplated chromium, but which will not be dissolved in hydrochloric or sulphuric acids, is needed, and tungsten is the metal of the chromium series of the periodic system which answers this requirement. This metal is not dissolved by any of the common mineral acids or by aqua regia. A mixture of nitric and hydrofluoric acids will attack it, but with either acid alone the action is slight. A thick coating of metallic tungsten which can be plated on other metals and which is not dissolved by acids is especially valuable as a covering for metal surfaces in chemical plants.

Many properties of tungsten make it desirable as a coating for other metals. It is silvery white in color and does not tarnish in dry air, neither sulphur nor phosphorus has any action on the metal; and it has a hardness of about seven. Its good heat conductivity, high melting point and hardness make it suitable for electrical contacts and arcing points subject to great temperature changes.

Table I—Effect of Current Density

(Saturated solution of sodium tungstate)

Current Density amp./sq.dm.	Weight After 10 Minutes grams/sq.dm.	Weight After 30 Minutes grams/sq.dm.
26.75	0.0263	0.0511*
13.36	0.0224	0.0302
8.9	0.0124	0.0232
6.7	0.0093	0.0139
5.4	0.0046	0.0093

* Not coherent.

The present investigation was carried out with the idea of producing a tungsten coating with a high resistance to acids and oxidation. The high melting point of this metal and the difficulty in working it even at high temperatures point to electrodeposition as the only practical means of producing a coating of such a metal.

A study of the conditions under which tungsten metal could be plated from alkaline tungstates was prompted by the discovery that a deposit of tungsten metal could be produced upon the electrolysis of hot, aqueous solutions of such compounds.

The product obtained on electrolysis at room temperatures of sodium tungstate solutions probably was a mixture of WO_2 or WO and finely divided metal. It had no crystalline structure which was visible under a microscope. When the solution was heated to 80 deg. C. and electrolyzed under similar conditions, the cathode became covered with a thin layer of a beautiful silver-white metal having the same highly polished surface as the brass it covered.

Without affecting the quality of the deposit the cathode current density was varied within wide limits. The best yield of tungsten metal for the solution employed was obtained at current densities between 75 and 100 amp./sq.ft. (8 to 10.7 amp./sq.dm.). Good deposits were made, however, using as high as 400 amp./sq.ft. (43.2 amp./sq.dm.). The higher the current density used, the quicker the thickness of deposit was reached at which pits began to form. Table I shows the deposit formed during one run for five different current densities.

The sodium carbonate solution to which tungstic acid has been added is in most respects a good plating bath. It is easily made up; it is neither poisonous nor corrosive; the salts can be readily obtained on the market and in a pure condition; the tungsten deposit produced is clean and bright; and no addition agent, such as glue, is necessary. But the bath is not entirely stable on electrolysis, and the solution slowly deteriorates when used constantly.

Table II—Voltage-Temperature Relations

(Sodium tungstate-sodium carbonate solution)

Temperature Deg. C.	Amp./sq.in.	Amp./sq.cm.	Volts: Anodes to Cathode	Volt Drop 0.8 mm. From Cathode
20	0.72	0.11	6.0	0.57
35	0.72	0.11	5.0	0.50
55	0.72	0.11	4.6	0.47
80	0.72	0.11	4.0	0.45
95	0.72	0.11	4.0	0.48
20	0.72	0.11	6.0	0.57
40	1.10	0.17	6.0	0.66
55	1.15	0.18	6.0	0.70
55	1.15	0.18	6.0	0.76*
80	1.38	0.21	6.0	0.85
95	1.60	0.25	6.0	1.04

* Cathode completely covered with metallic tungsten.

Voltage measurements from anode to cathode, and from a point $\frac{1}{32}$ in. (0.8 mm.) from the cathode to the cathode, were made at various temperatures to find out whether a rise in temperature caused an increase in the hydrogen overvoltage. Table II lists the values observed at both constant current density (0.11 amp./sq.cm.) and constant voltage (6) conditions when a sodium carbonate-sodium tungstate bath was electrolyzed at various temperatures. A quick rise in the cathode overvoltage occurred at the instant the brass cathode became covered with a visible film of tungsten (at 55 deg. C.).

It was found that the deposit formed on electrolyzing a solution of sodium hydroxide, dextrose, and sodium tungstate with a nickel anode became thick sooner than those formed when using a platinum anode. Deposits were bright, shiny metal, insoluble in hydrochloric acid or in sodium hydroxide. This deposit suggested an alloy of tungsten and nickel, since it had the chemical resistance of each.

Other metals were tried as anodes in the tungsten-plating baths to produce other alloys. Iron gave results similar to nickel. Smooth, bright deposits were produced in either the sodium hydroxide or sodium carbonate-tungstate baths by the prolonged use of an iron anode, or by the addition to the bath of small amounts of iron oxalate, or by the use of ferro-tungsten (80 per cent W) as anode material. The iron alloys were not as chemically resistant, however, as the corresponding nickel alloys, and darkened slightly on exposure to moist air.

Based upon a paper, "The Electrodeposition of Tungsten From Aqueous Solutions," presented before the Electrochemical Society, Birmingham, Ala., April 27, 1931.

Economic Analysis of the Process Industries

A statistical study of chemical engineering production, based on preliminary data from the 1929 Census of Manufactures (corrected to Dec. 31, 1930), and compiled from figures supplied by Grace W. Knott, Assistant Chief of Industrial Marketing, Census of Distribution, Bureau of the Census, U. S. Department of Commerce, Washington, D. C.

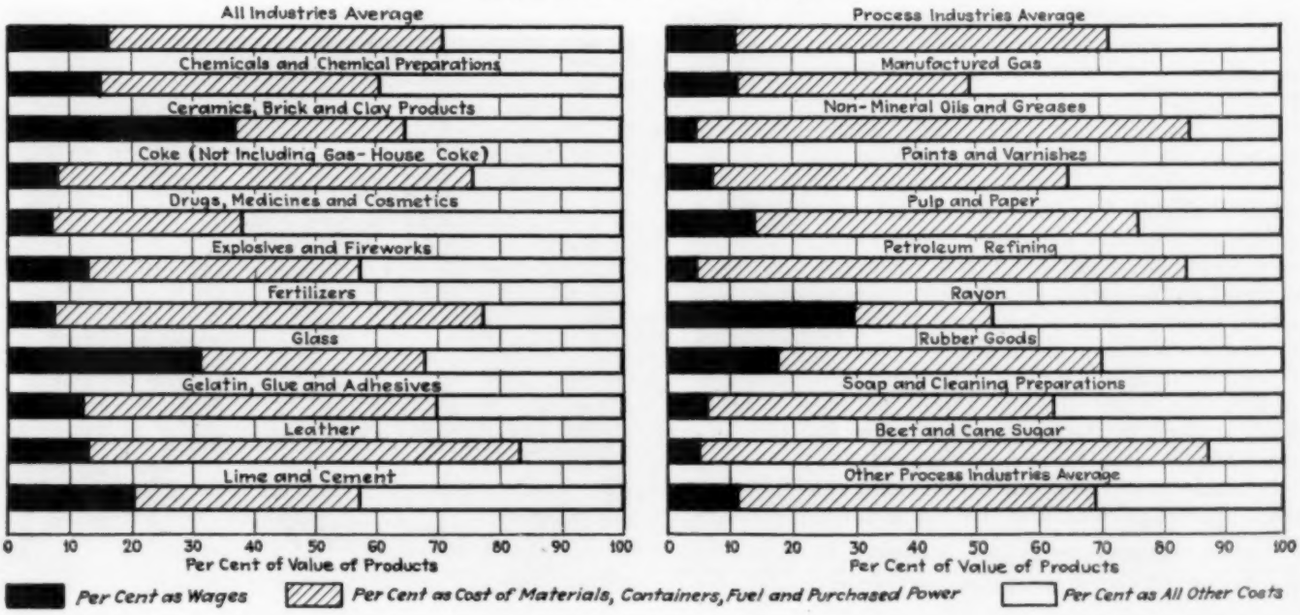
Industry	Value of Products	Wages *		Cost of Materials, Containers, Fuel and Purchased Electric Power		All Other Costs*	
		Dollars	Per Cent of Value	Dollars	Per Cent of Value	Dollars	Per Cent of Value
Chemicals and Chemical Preparations	$1,058,924,706	152,401,434	14.4	493,185,451	46.5	413,337,821	39.1
Alcohol, ethyl	41,247,052	1,793,933	4.3	27,016,863	65.5	12,436,256	30.2
Chemicals not elsewhere classified	725,600,389	95,298,537	13.1	360,297,173	49.7	270,004,679	37.2
Acids	96,710,078	.....	....	.....	....	.....	....
Nitrogen compounds	38,069,502	.....	....	.....	....	.....	....
Sodium compounds	132,996,671	.....	....	.....	....	.....	....
Potassium compounds	9,948,007	.....	....	.....	....	.....	....
General inorganic compounds	200,209,153	.....	....	.....	....	.....	....
General organic compounds	138,830,970	.....	....	.....	....	.....	....
Miscellaneous chemicals	108,836,008	.....	....	.....	....	.....	....
Compressed and liquefied gases	51,493,571	5,214,010	10.1	14,200,589	27.6	32,078,972	62.3
Photographic materials	102,152,747	20,145,941	19.7	30,256,830	29.6	51,749,976	50.7
Salt	37,663,418	6,676,691	17.7	13,600,364	36.1	17,386,363	54.2
Tanning materials, natural dyestuffs, mordants, assistants and sizes	34,374,239	2,797,694	8.1	22,431,495	65.3	9,145,050	26.6
Turpentine and rosin	36,776,000	15,193,000	41.3	10,556,000	28.7	11,027,000	30.0
Wood distillation and charcoal manufacture	29,617,290	5,281,628	17.8	14,826,137	50.1	9,509,525	32.1
Ceramics, Brick and Clay Products	413,362,646	153,408,416	37.1	112,260,575	27.2	147,693,655	35.7
Clay products and non-clay refractories	298,680,515	108,812,755	36.4	83,151,899	27.9	106,715,861	35.7
Crucibles	2,820,566	411,941	14.6	991,960	35.2	1,416,665	50.2
Pottery, including porcelain ware	108,757,233	43,365,195	39.8	27,136,435	25.0	38,255,603	35.2
Sand-lime brick	3,104,332	818,525	26.4	980,281	31.5	1,305,526	42.1
Coke (not including gas-house coke)	420,651,027	34,421,036	8.2	285,804,072	67.9	100,425,919	24.9
Drugs, Medicines and Cosmetics	641,085,273	45,776,923	7.1	200,540,075	31.2	394,768,275	61.7
Drug grinding	9,633,159	828,457	8.6	5,652,688	58.7	3,152,014	32.7
Druggists' preparations	126,647,771	12,850,209	10.2	44,130,461	34.8	69,667,101	55.0
Patent and proprietary medicines and compounds	313,764,874	18,554,928	5.9	92,630,984	29.5	202,578,962	64.6
Perfumes, cosmetics and other toilet preparations	191,039,469	13,543,329	7.1	58,125,942	30.4	119,370,198	62.5
Explosives and Fireworks	81,108,458	10,632,674	13.2	35,693,614	44.0	34,782,170	42.8
Fertilizers	219,001,224	17,295,647	7.9	151,634,635	69.2	50,070,942	22.9
Glass	289,274,502	89,954,805	31.1	106,470,665	36.8	92,849,032	32.1
Gelatin, Glue and Adhesives	40,411,781	4,875,574	12.1	23,390,177	57.8	12,146,030	30.1
Glue and gelatin	32,458,019	4,236,092	13.1	18,978,027	58.5	9,243,900	28.4
Mucilage, paste and other adhesives	7,953,762	639,482	8.0	4,412,150	55.8	2,902,130	36.5
Leather (tanned, curried and finished)	481,757,189	63,910,687	13.3	335,913,372	69.7	81,933,130	17.0
Lime and Cement	291,626,605	58,663,484	20.1	107,836,290	37.0	125,126,831	42.9
Gas (manufactured, illuminating and heating)	519,904,808	61,206,478	11.8	192,392,493	37.0	266,305,837	51.2
Oils and Greases (animal and vegetable)	589,297,343	27,798,327	4.7	468,932,808	79.6	92,566,208	15.7
Grease and tallow, not including lubricating greases	55,694,856	7,192,513	12.9	37,741,154	67.8	10,761,189	19.3
Lubricating greases, not made in petroleum refineries	70,475,222	3,419,224	4.8	42,231,963	60.0	24,824,035	35.2
Oil, cake and meal, cottonseed	297,184,158	11,000,777	3.7	250,710,372	84.4	35,473,009	11.9
Oil, cake and meal, linseed	117,428,873	4,016,700	3.4	100,016,666	85.2	13,395,507	12.4
Oils, essential	6,896,235	334,236	4.8	4,027,385	58.4	2,534,614	46.8
Oils, not elsewhere classified	41,617,999	1,834,877	4.4	34,205,268	82.2	5,577,854	13.4
Paints and Varnishes	563,031,490	41,824,559	7.4	320,703,102	57.0	200,503,829	35.6
Paper and Pulp	1,189,000,000	170,028,000	14.3	731,801,000	61.5	287,171,000	24.2
Petroleum Refining	2,611,680,940	125,948,505	4.8	2,055,734,186	78.7	429,998,249	16.5
Rayon	149,276,487	44,704,134	29.9	33,291,359	22.3	71,280,994	47.8
Rubber Goods	1,122,054,874	205,695,909	18.3	580,355,283	51.7	336,003,682	30.0
Soap and Cleaning Preparations	346,155,358	21,742,190	6.3	191,660,304	55.3	132,752,864	38.4
Cleaning and polishing preparations	42,778,000	3,121,500	7.3	16,888,000	39.6	22,768,500	53.1
Soap	303,377,358	18,620,690	6.1	174,772,304	57.6	109,984,364	36.3
Sugar	631,965,891	29,241,398	4.6	521,833,386	82.6	80,891,107	12.8
Beet sugar	108,349,385	9,989,855	9.2	71,948,440	66.4	26,411,090	24.4
Cane sugar, not including products of refineries	16,227,244	1,401,050	8.6	11,220,851	69.2	3,605,343	22.2
Cane-sugar refining	507,389,262	17,850,493	3.5	438,664,095	86.4	50,874,674	10.1
Other Process Industries	638,257,237	70,856,275	11.1	368,539,084	57.8	198,861,876	31.1
Artificial leather	32,961,252	2,955,702	9.0	22,267,938	67.6	7,737,612	23.4
Blacking, stains and dressing	24,182,990	1,917,222	7.9	8,213,072	33.9	14,052,696	58.2
Bluing	1,342,698	104,457	7.8	458,869	34.2	779,372	58.0
Bone black, carbon black and lamp black	20,720,772	2,677,329	12.9	10,129,640	48.9	7,913,803	38.2
Candles	6,266,524	854,098	13.6	2,905,879	46.4	2,506,547	40.0
Fuel, manufactured	8,358,824	5,405,947	64.7	497,820	5.9	2,455,057	29.4
Graphite, ground and refined	3,759,969	627,235	16.7	1,457,860	38.7	1,674,874	44.6
Ink, printing	42,448,750	3,994,234	9.4	18,740,019	44.1	19,714,497	46.5
Ink, writing	4,570,964	476,095	10.4	1,980,039	43.3	2,114,830	46.3
Linoleum and asphalt base floor coverings	88,225,958	11,926,021	13.6	41,302,452	46.8	34,997,485	39.6
Matches	19,490,000	3,983,000	20.4	12,245,000	62.9	3,262,000	16.7
Oilcloth	23,107,272	2,144,067	9.3	14,924,651	64.5	6,038,554	26.2
Asphalt and tar roofing materials	103,155,164	8,835,730	8.5	59,461,626	57.6	34,857,808	33.9
Wall plaster, wall board and floor composition	69,499,100	10,098,138	14.5	27,832,219	40.0	31,568,743	45.5
Wood preserving	190,167,000	14,857,000	7.8	146,122,000	76.9	29,188,000	15.3
Process Industries, Total	$12,297,827,839	1,430,386,455	11.6	7,317,971,931	59.5	3,549,469,451	28.9
All Industries, Total	$69,417,515,929	11,421,631,054	16.5	37,730,454,799	54.3	20,265,430,076	29.2

*"All Other Costs" includes salaries, overhead expenses, rent, insurance, maintenance, depreciation, interest, selling expenses, manufacturers' profits, etc.

Process Industries Arranged by Decreasing Ratios of Wages; Materials, Containers, Etc.; and All Other Costs, to Total Values of Products

Wages		Materials, Containers, etc.		All Other Costs	
Industry	Per Cent	Industry	Per Cent	Industry	Per Cent
Fuel (manufactured)	64.7	Cane sugar refining	86.4	Patent medicines	64.6
Turpentine and rosin	41.3	Oil, linseed	85.2	Perfumes	62.5
Pottery	39.8	Oil, cottonseed	84.4	Gases, compressed and liquefied	62.3
Ceramic materials, avg.	37.1	All sugar, avg.	82.6	Drugs and cosmetics, avg.	61.7
Clay products and refractories	36.4	Oils, not elsewhere classified	82.2	Blacking, etc.	58.2
Glass	31.1	Oils and greases, avg.	79.6	Bluing	58.0
Rayon	29.9	Petroleum	78.7	Druggists' preparations	55.0
Sand-lime brick	26.4	Wood preservation	76.9	Salt	54.2
Matches	20.4	Leather	69.7	Cleaning compounds	53.1
Lime and cement	20.1	Cane sugar (not at refineries)	69.2	Gas (manufactured)	51.2
Photographic materials	19.7	Fertilizers	69.2	Photographic materials	50.7
Rubber goods	18.3	Coke	67.9	Crucibles	50.2
Wood distillation	17.8	Grease and tallow	67.8	Rayon	47.8
Salt	17.7	Artificial leather	67.6	Oils, essential	46.8
Graphite	16.7	Beet sugar	66.4	Ink, printing	46.5
All Industries, avg.	16.5	Ethyl alcohol	65.5	Ink, writing	46.3
Crucibles	14.6	Tanning materials	65.3	Wall plaster	45.5
Wall plaster	14.5	Oilcloth	64.5	Graphite	44.6
Chemicals and chemical preparations, avg.	14.4	Matches	62.9	Lime and cement	42.9
Paper and pulp	14.3	Paper and pulp	61.5	Explosives and fireworks	42.8
Candles	13.6	Lubricating greases	60.0	Sand-lime brick	42.1
Linoleum	13.6	**All Process Industries,** avg.	59.5	Candles	40.0
Leather	13.3	Drug grinding	58.7	Linoleum	39.6
Explosives and fireworks	13.2	Glue and gelatin	58.5	Chemicals and chemical preparations, avg.	39.1
Chemicals, not elsewhere classified	13.1	Oils, essential	58.4	Bone black and other blacks	38.2
Glue and gelatin	13.1	Soap	57.6	Chemicals not elsewhere classified	37.2
Grease and tallow	12.9	Tar, etc., roofing	57.6	Mucilage and other adhesives	36.5
Bone black and other blacks	12.9	Paints and varnishes	57.0	Soap	36.3
Gas (manufactured)	11.8	Mucilage and other adhesives	55.8	Clay products and refractories	35.7
All Process Industries, avg.	11.6	**All Industries,** avg.	54.3	Ceramic materials, avg.	35.7
Ink, writing	10.4	Rubber goods	51.7	Paints and varnishes	35.6
Druggists' preparations	10.2	Wood distillation	50.1	Lubricating greases	35.2
Gases, compressed and liquefied	10.1	Chemicals not elsewhere classified	49.7	Pottery	35.2
Ink, printing	9.4	Bone black and other blacks	48.9	Tar, etc., roofing	33.9
Oilcloth	9.3	Linoleum	46.8	Drug grinding	32.7
Beet sugar	9.2	Chemicals and chemical preparations, avg.	46.5	Wood distillation	32.1
Artificial leather	9.0	Candles	46.4	Glass	32.1
Drug grinding	8.6	Ink, printing	44.1	Ethyl alcohol	30.2
Cane sugar (not at refineries)	8.6	Explosives and fireworks	44.0	Rubber goods	30.0
Tar, etc., roofing	8.5	Ink, writing	43.3	Turpentine and rosin	30.0
Coke	8.2	Wall plaster	40.0	Fuel (manufactured)	29.4
Tanning materials	8.1	Cleaning compounds	39.6	**All Industries,** avg.	29.2
Mucilage and other adhesives	8.0	Graphite	38.7	**All Process Industries,** avg.	28.9
Fertilizers	7.9	Lime and cement	37.0	Glue and Gelatin	28.4
Blacking, etc.	7.9	Gas (manufactured)	37.0	Tanning materials	26.6
Wood preserving	7.8	Glass	36.8	Oilcloth	26.2
Bluing	7.8	Salt	36.1	Coke	24.9
Paints and varnishes	7.4	Crucibles	35.2	Beet sugar	24.4
Cleaning compounds	7.3	Druggists' preparations	34.8	Paper and pulp	24.2
Drugs and cosmetics, avg.	7.1	Bluing	34.2	Artificial leather	23.4
Perfumes	7.1	Blacking, etc.	33.9	Fertilizers	22.9
Soap	6.1	Sand-lime brick	31.5	Cane sugar (not at refineries)	22.2
Patent medicines	5.9	Drugs and cosmetics, avg.	31.2	Grease and tallow	19.3
Petroleum	4.8	Perfumes	30.4	Leather	17.0
Oils, essential	4.8	Photographic materials	29.6	Matches	16.7
Lubricating greases	4.8	Patent medicines	29.5	Petroleum	16.5
Oils and greases, avg.	4.7	Turpentine and rosin	28.7	Oils and greases, avg.	15.7
All sugar, avg.	4.6	Clay products and refractories	27.9	Wood preserving	15.3
Oils, not elsewhere classified	4.4	Gases, compressed and liquefied	27.6	Oils, not elsewhere classified	13.4
Ethyl alcohol	4.3	Ceramic materials, avg.	27.2	All sugar, avg.	12.8
Oil, cottonseed	3.7	Pottery	25.0	Oil, linseed	12.4
Cane sugar refining	3.5	Rayon	22.3	Oil, cottonseed	11.9
Oil, linseed	3.4	Fuel (manufactured)	5.9	Cane sugar refining	10.1

Graphical Comparison of Wages; Materials, Containers, etc.; and All Other Costs in Major Process-Industry Groups



The Whys and Hows in

LEATHER MANUFACTURE

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Written for engineers who use, rather than make, leather, this paper gives an admirably clear and understandable account of the mechanism of leather technology. The present article deals with the subject in general, and with heavy leather. A later article will discuss light leather and leather uses.

SKINS of many animals, particularly of the mammalia, constitute a natural raw material of extraordinary physical properties, a material which becomes even more valuable when properly modified in structure. This modified material is called leather. It has been manufactured for thousands of years and the technique of making it probably has changed less than that of any other important industry. However, in the last few decades modern scientific developments have brought striking changes in the art of leather manufacture and a better knowledge of the nature both of the hide with which the tanner starts and of the leather he produces from it. It is the purpose of this paper to outline briefly the important points in the production of leather, not for the information of the tanner who is already familiar with them but in the endeavor to give the large body of engineers who use leather a clearer insight into its properties, its various modifications, its limitations, and its potentialities.

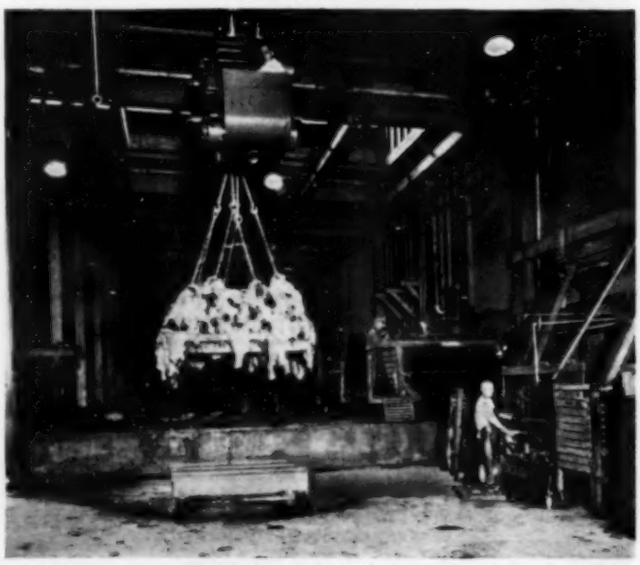
Animal skins from which leather is made consist of a natural fabric of interwoven fibers. As removed from the animal, this fabric is accompanied by dirt and blood, the hair, the outer skin or epidermis, and the adhering loose connective tissue which bonds the skin to the other structures of the body, the so-called flesh. These must be removed, but even after this is done the remaining fabric, so-called raw hide, while tough and strong, possesses two exceedingly serious limitations. The fibers of the fabric are proteins in chemical structure and, while insoluble in water unless decomposed, they are extremely sensitive to water. They swell in it and are somewhat plasticized by it and when the water is removed by evaporation the plasticized fibers cement themselves together into a hard and horny mass. Because of the plasticization of the fibers by water, the wet skin is extraordinarily stretchy. In other words, the skin is horn-like when dry and almost jelly-like when wet. Furthermore, in the presence of water the skin is extraordinarily sensitive to putrefaction.

Therefore, the problem of the tanner falls into two major parts; he must first free the skin from dirt, blood, and other adventitious material; remove hair, epidermis and flesh; and second, so treat the skin as adequately to reduce its sensitiveness to water and render it resistant to putrefaction. That department of the tannery in which the first series of operations is conducted is called the beam house. The second process is the tanning operation proper, converting the skin into leather. This must in turn be followed by a series of finishing operations designed to give the skin the proper mechanical feel, surface appearance, and waterproof or water-resisting characteristics.

A skin may come to the tanner substantially as removed from the animal, or it may have been salted or dried to protect it from putrefaction during storage and

Hides Are Soaked in Lime Pits to Loosen Hair Before Dehairing

Photographs courtesy of A. C. Lawrence Leather Co.



Slightly condensed from a paper presented at the June, 1931, meeting of the American Institute of Chemical Engineers, under the original title: "The Manufacture of Leather."

shipment. For all operations in the tannery it is essential that the skin be thoroughly hydrated. Dried skins are too brittle for rough treatment without damage and are, therefore, always soaked in pits at the start to secure this hydration and its concomitant plasticization. In the case of green skins long soaking is unnecessary. The skins are washed free of dirt and blood by tumbling in running water in large rotating cylinders, the so-called drums of the tannery. Ears, tail, and other addenda are trimmed off by hand.

From the skins thus cleaned and softened the hair is removed by selective chemical or bacterial action. The old method is to soak the skins for a number of days in saturated lime water. This attacks the tissue at the base of the hair follicle, the protein structure of which is the most sensitive point in the whole skin under these conditions of alkalinity. McLaughlin has shown the presence of amines as active auxiliary depilatories, evidently formed by some sort of protein decomposition, but it is not proved whether the attack is purely chemical or represents the action of organisms whose activity is decreased greatly by the presence of the alkali. In any case, both hair and epidermis are loosened and can readily be removed by scraping with a dull knife. The rotary knives of so-called unhairing machines are almost universally used today. An alternative method of hair removal involves dissolving the hair in a dilute solution of sodium sulphide. However, the strength required has an alkalinity sufficient distinctly to affect the skin. Sulphide is almost always added to the limes in small quantity to increase their activity. The ancient method of sweating, taking advantage of the fact that the tissue at the base of the hair follicles is more sensitive to putrefactive attack as well as chemical, is not often used today. The final operation of separating the skin from the adhering tissues is the fleshing operation, mechanically cutting off the connective tissue, largely by the rotating knives of the fleshing machine.

The slippery, slimy skin thus prepared consists, as stated above, of a fabric of natural fibers not only interwoven but to a large degree intergrown. If this skin is dried by evaporation of the water, the plastic fiber surfaces stick together and coalesce to produce a material very similar to parchmentized cellulose, such as parchment paper or vulcanized fiber. Unfortunately, however, since the dried fibers are stiff and cemented together firmly, the structure is much like horn. The tanner must so treat these fibers that their plasticity is reduced to a point where they will not coalesce and stiffen when they are dried.

However, the problem goes farther than this. The value of the skin depends on its fabric-like structure, but the tanner cannot, like the textile manufacturer, control the structure of his fabric. He must take the skin as nature gives it to him. He is completely unable to unravel or rearrange the threads. Any modifications he makes in the final structure must be made in spite of these limitations. He can, it is true, loosen the weave a bit by destroying and washing out certain of the substance of the skin. Thus, it seems likely that the persistence of the sweating operation of hair removal may be due to the fact that the putrefaction not only loosens the hair but destroys a small percentage of the finer fibers, thereby opening up the structure of the skin so as to make it a bit more distensible for the production of thick leather. There is no question but that the bating operation, treating the skin with a digestive enzyme in the presence of a buffer solution accurately to control the pH, dissolves and eliminates certain portions of the skin and is used for that reason. However, there is no doubt that these methods have relatively little effect on the structure of the skin as a whole.

FOR his most important technique in controlling the texture of the finished product, the tanner must resort to a device well known to the textile finisher, that of loading. If he wants a soft and flexible product, such as glove or upper leather, he will introduce the smallest possible quantity of loading material into the voids between the fibers. If, however, he desires a stiff, hard, boardy product, such as sole leather, in which flexibility, beyond a certain minimum, is undesirable but resistance to abrasive wear is essential, he will load heavily, so as to fill up all spaces between the fibers. Because of this, the tanning of leather falls into two major categories, the production of heavy leather and of light. In the former, one desires primarily thickness, stiffness, and freedom from stretch. In addition, one may desire, as in sole leather, primarily resistance to water penetration and to abrasive wear, or, as in belting leather, strength together with ability to endure repeated flexing. In the latter, the important characteristics are flexibility and strength. In no case, however, dare the tanner ignore the appearance of his product. Because of these differences in the specifications to which he must work, it is not surprising to find that the technique of operation of the heavy leather tanner is fundamentally distinct from that of the producer of light leather products.

Conversion of hide into leather requires the destruction of the sensitiveness of the protein to water by a method involving the minimum

Uniform Thickness of Hides Is Secured by Use of Rotary-Knife Shaving Machine Such as These

alteration of the character of the individual fibers, or of their mutual relations in the structure of the skin. The original fibers are a water-sensitive, organized gel. The means which the tanner employs to transform them is to precipitate upon them a colloid of opposite electrical charge.

Like all proteins the substance of the hide, consisting as it does of condensation products of a complex mixture of amino-acids, is amphoteric in character. It can combine with either acid or base. Its reaction with water-soluble acid involves the addition of the hydrogen ion of the acid to the basic nitrogen of the protein, thereby producing on the protein particle a positive charge. It reacts with soluble bases because of the presence in the protein structure of carboxyl groups, possessing their usual acidic properties. The ion which does not take part in the reaction—i.e., the anion of the acid or the cation of the base—while held in the neighborhood of the charge on the protein particle by electrostatic attraction, is none the less dissolved in the interstitial liquid and, therefore, the protein itself carries an otherwise unbalanced negative charge in basic solution and a positive one in acid. If brought into contact with any colloidal solution, the particles of which carry a charge opposite in sign to that on the hide substance, coprecipitation results, producing a larger aggregate. Increase in the size of such an aggregate always tends to render it more inert and more resistant to the action of solvents and reagents, chemical and otherwise. This is illustrated in the vulcanization of rubber, the oxidation of drying oils, the condensation of Bakelite, and almost numberless other cases.

FROM this point of view there ought to be a large number of materials available for the conversion of hide substance into leather. This is indeed true, but experience has shown that most of them are, for one reason or another, unsatisfactory. Thus, for some reason not understood, positive colloids used as precipitants for hide substance in basic solution usually produce an unsatisfactory product. It is obvious from the description of the unhairing methods outlined above that all these operate in basic media. The tanner must, therefore, get his skin on the acid side before converting it into leather. When this has been done, one must still avoid many negatively charged colloids, the use of which might at first be attempted. Thus, colloidal basic ferric salts will tan leather, but the product tends to crumble to dust, probably due to catalytic oxidation. In most cases the reasons for the unsatisfactoriness of the precipitated product are not understood. None the less, a relatively large number of precipitating agents are available and various types of leather are produced thereby.

Of the important precipitants the oldest are the tannins, complicated mixtures of complex glucosidic condensation products of polyphenolic bodies, widely distributed in the vegetable kingdom. They may be grouped into the astringent, powerfully precipitating tannins on the one hand, and the non-astringent, mild, slightly but none-the-less effectively absorbed tannins on the other. Next in importance are the basic complex derivatives of chromium hydroxide, produced in trivalent chromium solutions in the presence of suitable anions, particularly sulphate. The most essential difference between these two precipitants lies in the fact that very small percentages of chromium complex need be taken up by the hide in order to coagulate it sufficiently to render it completely water resistant, in the sense that it cannot be brought into solution without destruction, whereas far larger amounts of the tannins are required. However, the capacity of the skin to take up chromium is very limited, at least without deep-seated injury to it, whereas its capacity to take up tannins, particularly the astringent tannins, is very great indeed. It seems probable that after enough astringent tannin has been absorbed completely to coagulate the protein of the fiber, the coagulated aggregate still has capacity to absorb large additional quantities of the tanning agent, building up a particle of far greater size than that of the original fiber, thereby filling the voids and stiffening the structure. In consequence, the tannins, particularly the astringent tannins, are used predominantly for the production of heavy leather, whereas chromium is of outstanding importance in the manufacture of light.

FROM this it is clear that heavy leather is made from thick skins in which, after the fibers are converted into leather by tanning, a large quantity of excess tannin is precipitated in the stock in order to fill the voids and stiffen the structure. The two most important types of heavy leather are sole leather and belting.

In sole leather it is desirable to have the product thick and stiff in order to secure resistance to abrasive wear, even at the expense of tensile strength. However, it must not be brittle. In order to understand the tanning operation, certain important chemical factors must be kept in mind.

In the first place, while tannic acid will precipitate hide substance in a mildly alkaline medium, there will be formed in the presence of lime a certain amount of calcium tannate, which is subject to oxidation and darkening with the oxygen of the air. It is, therefore, necessary to neutralize and wash out the lime. However, when the hide is brought by this neutralization to its isoelectric point, it shrinks greatly and, if converted into leather in this condition, the product has essentially the thickness of the hide at the beginning of the tanning operation. However, the amphoteric hide can absorb a large quantity of acid. This absorbed acid causes the hide to swell, and if the hide be tanned while in this swollen condition and the pores adequately plugged up by precipitation of sufficient excess tannin, the finished leather will retain the thickness of the acid-plumped hide.

Furthermore, quite a little incipient tanning by mild, non-astringent tannins may be allowed to occur without having the hide lose its capacity to swell in dilute acid. Now the natural tannins contain sugars, either present as such or produced by hydrolysis during the tanning process. These sugars can undergo fermentation during the tanning operation, producing considerable quantities of weak organic acids which accumulate in the spent tan liquor. These are, therefore, available for neutralization of the lime and plumping of the skin, although synthetic acids, either mineral or organic, may be used, either for pretreatment of the skin before any tanning at all is undertaken, or for addition to spent tan liquors to build up their natural acid content. Finally, if one treat fresh hide with a strong solution of astringent tannins, the precipitation on the surface of the hide is so violent that the surface pores are plugged up and further penetration of the tannin by diffusion through the hide is rendered impossible, or at least inordinately slow. It is, therefore, clear that the treatment of the hide by the tan liquor should be a countercurrent oper-

ation, consisting of a relatively large number of steps.

In consequence of the facts stated above, the standard procedure for tanning sole leather is to wash the skins from the beam house to remove most of the alkali, and then treat with acid to neutralize and wash out the remaining lime and plump the skin. As indicated above, this is normally done in connection with the first stages of the countercurrent tanning process, by treating the washed hides with spent tan liquors of proper acidity. The hides are then treated with stronger and stronger liquids in a series of operations. In the first stages of the series, the liquors are almost always mildly agitated, the hides hanging in them suspended from sticks on rocker arms or equivalent devices. Toward the end of the series the hides may be thrown on top of each other in pits, the so-called "layers" of the tannery. However, especially during the earlier stages of treatment, the stock is protected from violent agitation or flexing because this is likely to cause the leather to fall; i.e., decrease in thickness.

It would seem that after the tanning operation has gone to a certain extent the affinity of the hide for the acid is largely lost so that the plumping action of the acid disappears. However, the hide will still retain its swollen shape unless handled roughly. Once the voids between the fibers have been plugged up with tannin, shrinkage becomes impossible. But this is a slow operation and weeks and even months are necessary to complete it. At the end of the operation the voids are still filled with a tannin solution, which, though strong, still contains a large quantity of water. It therefore becomes imperative to fill these voids with solids as completely as possible by running the hide through squeeze rolls, and immersing in a very concentrated tanning extract. To give time for the maximum penetration of tannin into the leather, it is usually allowed to soak in a pit covered with warm, concentrated extract, an operation called tempering. Other inert loading materials are often worked in by similar methods.

It is clear that this large amount of tannin taken up by the skin is forced from the outside inward. Consequently, the heaviest loading is on the surface. Now, the outer layer of the skin, the so-called grain surface, is built up of the most closely packed fibers and possesses the densest structure. When, therefore, one has submitted the skin as a whole to this loading operation to a degree sufficient adequately to plug up the voids in the center of the hide, the plugging effect on the grain surface has become excessive and the leather cannot flex when dried. But without excessive plugging, the resulting leather will be flabby and water-absorbing. It is, therefore, imperative to tan the leather so that it is adequately loaded through and through, and thereafter to remove the excess tanning material from the grain surface.

WHEN the loading with tannin is completed, the leather is dried. This is done slowly to minimize the movement of tannin from the interior toward the surface by capillarity. Now, to remove the excess of tannin from the surface layer, the leather is dipped in water to fill its voids and then for a moment in dilute alkali, usually sodium carbonate. The alkali chemically combines with the acid tannins in the surface voids and takes them into solution. The skin is then dipped in water to wash off these dissolved tannins, followed by dilute acid to neutralize the alkali and finally by water to remove the surface acid. This operation is called *bleaching*, because it removes the darker colored, astringent tannins left in the surface at the end of the tanning operation and the action of the acid is to lighten still further the color of those which remain. However, its most important function is the elimination of brittle grain by the removal of the excess tannins in the voids of the grain surface, thereby making it possible for the grain fibers to flex and bend.

Before the final drying of the leather, a certain amount of oil or grease is introduced. This may be bone by "fat liquoring," i.e., drumming the leather in a water emulsion of the oil or fat; or by "stuffing," i.e., drumming in liquid fat, using heat if necessary; or by "swabbing" or "oiling off," with clear oil or an emulsion. However, in the case of sole leather, an oil emulsion (e.g., sulphonated cod oil) usually is introduced with the tanning extract in the loading operation, additional fat being applied later by swabbing.

It was formerly felt that the major function of fatty substances in the leather was water proofing and lubrication of the fibers, to promote flexing. No doubt these factors are important, but even more essential is the action of the fat in preventing the coalescence of the fibers on drying. The tannins precipitated on and between the fibers are water soluble. Furthermore, they form in water emulsoidal solutions which, when concentrated, become extremely viscous, sticky, glue-like materials. If, therefore, one dries down a piece of wet leather, as the tannin solutions between the fibers concentrate the fibers become glued together so that the whole mass sets and hardens as it dries to a veritable piece of horn. If, now, in the final stages of manufacture, one will incorporate into the leather globules of oil or fat, these will insulate the fibers from each other and to a large degree prevent their adhesion during drying. Therefore, in the dried products the fibers are relatively free to slip over each other, making it possible for the leather to flex. This is always a major function of the fatty substances incorporated in leather and sometime their sole function. Thus, leather for japanning must be fat liquored for this reason, but the grease incorporated must then be extracted by naphtha to prevent injury to the ultimate finish.

FINAL stages of finishing the leather involve moistening the dried product sufficiently to make it flexible, oiling off with emulsions, part of which penetrate and part remain on the surface to give it a proper gloss, followed by rolling, to increase the density of the leather and give it a surface gloss, finally drying to a moisture content in substantial equilibrium with the air.

The manufacture of belting leather differs from that of sole in three essential particulars. Belting must be strong and flexible, but not stretchy. Therefore, in the first place, in its manufacture one uses enough acid to remove the lime but not enough to plump the hide. This leaves the maximum amount of hide fiber per unit of cross section to give it the strength required. In the second place, while one tans thoroughly, one does not load to the limit. This gives enough filling of the voids to reduce stretch, but not enough to make the product stiff. Finally, belting is *stuffed;* that is, tumbled or dipped in grease warm enough to be fluid. This incorporated grease separates every fiber in the final product from its neighbor and likewise furnishes the lubrication so necessary to reduce to the lowest possible point the friction between the fibers which results from their repeated flexing.

Producing Dry Salt by Diverting Heat of Reaction

By GIACOMO FAUSER
Industrial Engineer
Novara, Italy

GROWING from thermal inconsistencies and other faulty economies in the traditional methods for preparing ammonium salts, the process about to be described was devised to make their industrial production as nearly as possible chemically perfect by adaptation of modern technology to a study of the reaction data. This was especially desirable in view of the present keen competition between all fertilizers on an already glutted market. The success of the process is best illustrated by the enumeration of the commercial plants now using it for producing ammonium sulphate:

Company	Location	Daily Output Tons
Soc. Darda Ammonia	Oschiri, Italy	40
Stickstoffwerke Osvag	Waldenburg, Germany	200
Soc. Neerlandaise de l'Azote	Sluiskil, Holland	600
Soc. Ammoniaque Synthétique	Willebroeck, Belgium	160
Soc. Ammonium	Wyry, Poland	100
Fabrique Nationale	Tarnow, Poland	80

The ordinary method of making ammonium salts consists of saturating the different acids with ammonia, followed by crystallization. The reaction takes place in a liquid acid medium, hence the salt formed is both wet and acid. Furthermore, each step in the process requires individual units of equipment, all susceptible to corrosion from the acid condition.

In the new process, a layout of which appears in the diagram, the underlying principle is the combination of ammonia and sulphuric acid in a gaseous state, whereby the heat of reaction drives off the water and the salt forms as a dry neutral product. Briefly, the process in the diagram shows the sulphuric acid flow by gravity through a washing tower, against the effluent reaction vapors, down to a spraying device in the top of the reaction chamber. From the bottom of the chamber, gaseous ammonia ascends from a peripheral ring and then reacts with the descending sulphuric acid, the heat of reaction driving off the water vapor. The salt meanwhile drops below, a rake removes it from the chamber to a spiral conveyor, and residual ammonia vapors are sucked up to the washing tower.

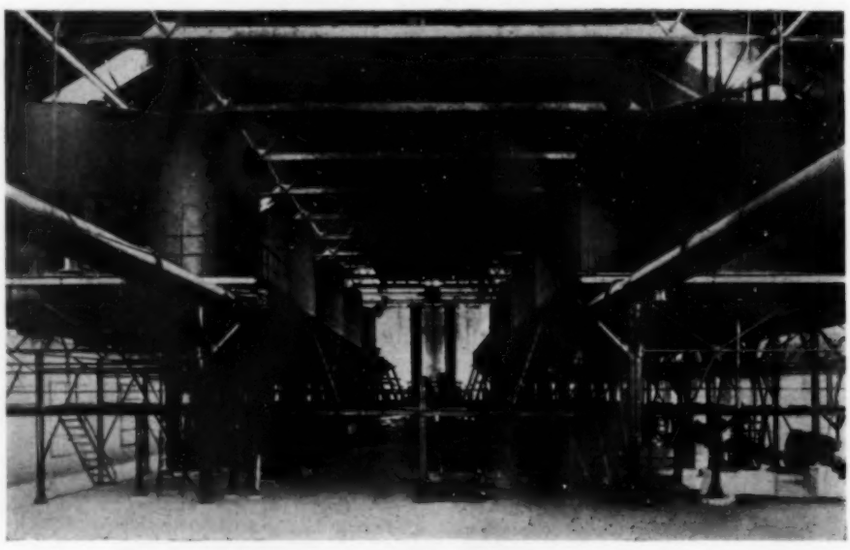
Utilizing Heat of Reaction

The thermal balance on which the reaction primarily depends is the release of 355 calories for each kg. of sulphate produced. The concentration of sulphuric acid must be such that the heat generated can drive off the water completely. In the production of 1 kg. of ammonium sulphate it is necessary to use 0.257 kg. of ammonia and 0.743 kg. of sulphuric acid; that is, 1.137 kg. for 52 deg. (65.5 per cent) acid.

Using this concentration for neutralization, one obtains a solution of 73.5 per cent ammonium sulphate with a boiling point of 108.2 deg. C. Assuming an initial temperature of 20 deg. C. and a mean specific heat of 0.42 between 73.5 and 100 per cent, the heat necessary to attain the boiling point is 0.42 (108.2 — 20) 1.394 = 51.5 calories. Again, the heat of vaporization of all the water figures out to 210 calories, so that the balance remains 110.9 calories per kilogram as an ample surplus to take care of any heat losses by convection or radiation.

It is, therefore, evident that since each kilogram of sulphate releases 0.394 kg. of water vapor to be eliminated, and since this vapor carries a considerable quantity of ammonia with it, it is necessary to provide for recovery. To this purpose the vapor leaving the reaction chamber is introduced into the bottom of the washing tower filled with Raschig rings, in which the sulphuric acid is passing downward. Thus the ammonia is absorbed while the water vapor passes on to the atmosphere above. Of course, the ammonia is pretty well diluted as it leaves

At Sluiskil, Holland, Is Largest Fauser Process Plant, With 600 Tons $(NH_4)_2 SO_4$ Daily Capacity



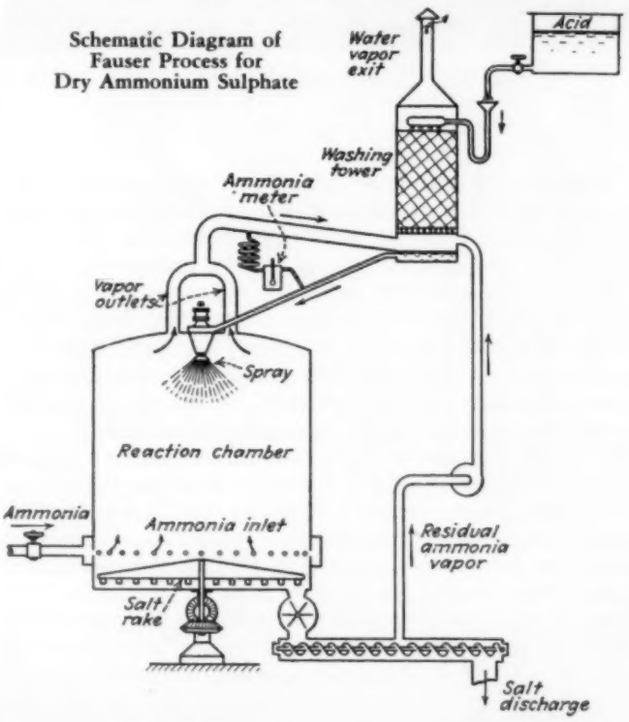
the chamber, although at the bottom it is practically pure and insures a perfect neutralization of the descending acid.

Since the concentration of ammonia in the chamber plays an important part in the quality of the salt, it was necessary to apply some continuous control. The apparatus adopted consists of a small condenser tapping the exit gas line, and the condensed fluid is continuously checked for its ammonia content by a density recorder. The ammonia content in the condensed liquid is equivalent to that present in the effluent gases and should not indicate below 12-15 per cent in order to assure perfect neutralization in the chamber.

The economies effected by this process, shown in two plant views in the illustrations, apply not only to initial installation but also to operating costs and the elimination of replacement due to acid corrosion.

Applying Process to Mixed Salts

This process is advantageously applicable also to the production of ammonium sulphonitrate. The latter contains 26 per cent nitrogen (6 per cent nitric and 20 per cent ammoniacal). It may be considered a mixture of 33 per cent ammonium nitrate and 67 per cent sulphate,

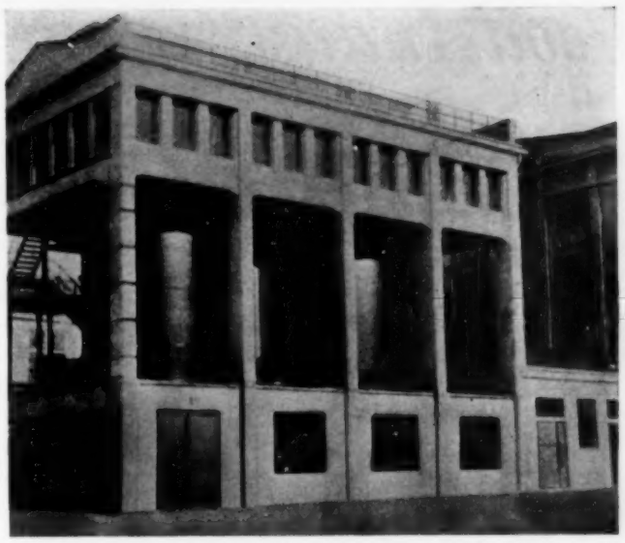


Schematic Diagram of Fauser Process for Dry Ammonium Sulphate

which is very favorable to the immediate and ulterior needs of a crop. Of course, the relatively high content of nitrogen also makes it favorable from the standpoint of shipment, so that it has already won itself a place on the market.

Nevertheless, the preparation of this salt by mixture of the individual salts is a costly operation. On the other hand, the application of the process described for producing it in one operation has proved very economical. By the use of 60 deg. sulphuric acid and 36 deg. nitric acid the heat of reaction becomes sufficient to evaporate the water contained in both acids, so that all other concentration methods are eliminated. The economies calculated for this process come up to $1.50 per ton of sulphonitrate.

Difficulties also have retarded the growth of a combined phosphate fertilizer such as ammonium sulpho-


Plant at Tarnow, Poland, Producing 80 Tons of Dry $(NH_4)_2 SO_4$ Daily

phosphate. Electrothermic phosphoric acid is too expensive and sulphuric-acid process acid is too dilute to make this combination economical. But the latter can be used advantageously in the new process, because with 60 deg. sulphuric acid the excess heat released is sufficient to evaporate the excess water in the phosphoric acid, so that a dry salt is immediately produced.

In this way a fertilizer is produced containing 20 per cent nitrogen and 20 per cent of P_2O_5 completely soluble in water; in other words, the same value as a mixture of super-phosphate and ammonium sulphate but without as many inert constituents. All in all, one may conclude that the essential principle of spraying acid through an ammonia atmosphere is a most advantageous solution to the production of these salts.

▼ ▼

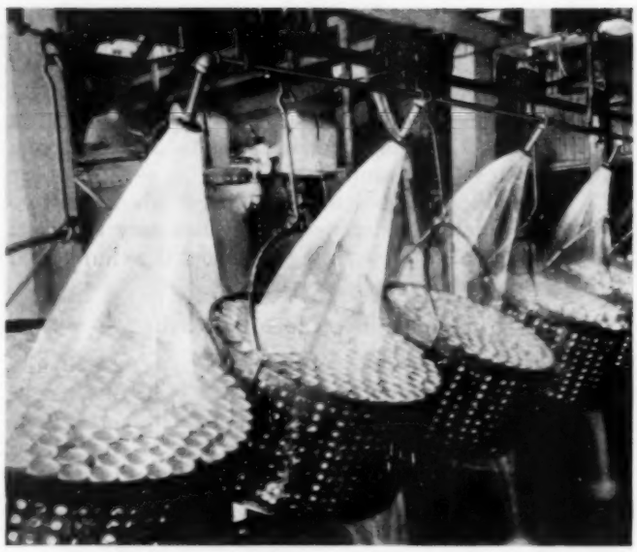
Glass Manufacture in Modern Cloak

AT THE summer school of the University of Michigan, Ann Arbor, in July, a very comprehensive summary of the glass industry, which has been transformed so thoroughly in recent years, was given by E. C. Sullivan, vice-chairman of the Corning Glass Works, Corning, N. Y. Recently mechanized, the industry can now be divided into three general manufacturing groups: flat glass, including thin stock for safety glass; bottles and other containers; and miscellaneous forms including bulbs, laboratory and industrial ware.

Common to all types is the progress in melting and annealing technique. New continuous furnaces, similar to the open-hearth, involve much larger batches and more refined heat and refractory technique, although the fuel efficiency in melting is still around 10 per cent. Advances in annealing include the "heatless" lehr, which provides treatment in two to three hours, and the electrically heated lehrs (described in *Chem. & Met.*, 400-403, July, 1931). Especially notable progress is evident in plate glass, where, due to the pressure of safety glass demand, $\frac{1}{8}$-in. sheet is now drawn continuously by several processes, differing in principle. Two other interesting steps are plant-scale equipment of glass (*Chem. & Met.*, 227, April, 1931) and the study of relationship between composition and properties of different glasses.

Food Industry a Future Field for Chemical Engineers

By LAURENCE V. BURTON
Editor, Food Industries
New York City



Cooling Cans Continuously by the Spray Method

FOOD MANUFACTURE, in spite of its being the largest single group of manufacturing industries in the United States, is nevertheless only one specialized branch of chemical engineering. The food industry differs basically from other process industries only in a few minor respects, mainly in the fact that its processes require biological control, while its products are edible and subject in most cases to spoilage. Hence food manufacture calls for closer sanitary supervision than is necessary in most other process industries.

First, I want to convey some idea of the relation of food processing to all manufactures in the United States. Food manufacturing plants in this country comprise 27 per cent of all plants having an annual output in excess of $20,000 per year. About 8½ per cent of all wage earners in the country are engaged in food manufacture. This, of course, does not include those who work in either the raising of foodstuffs or the distribution of manufactured products. Similarly, the annual value of manufactured food products, more than eleven billion dollars, or 15 per cent of the value of all manufactures, does not begin to cover the retail food bill of the country, which is very nearly double this figure.

That food manufacture is highly industrialized is clearly shown by the fact that, while the average output per wage earner in all industries in the United States is $8,000 per year, the average in the food industry is twice that, or $16,000.

Why, then, in this largest of all chemical engineering industries, are there so few chemical engineers? Many of the same unit operations found in other process industries occur time and again in food manufacture. Chemical engineers will find a familiar ring in the names of many of the following unit operations employed in the food industry:

Storing	Materials handling
Mixing	Grinding
Disintegrating	Micro-disintegrating
Kneading and working	Baking
Heating and roasting	Evaporating
Distilling and vacuum distilling	Sterilizing
Fumigating	Desiccating and drying
Cooling	Beating and whipping
Centrifugal separating	Churning
Freezing	Pressing
Expelling	Aging
Bleaching	Coloring
Hydrolizing	Crystallizing

Many of the operations' names are identical, and many more have evident parallels in other branches of chemical engineering. And yet, these include only the most important of the unit operations of food processing.

It seems to me that there are two principal reasons why chemical engineering has as yet made such a small impression on food manufacture. For one thing, the food industries are only now emerging from the state in which other process industries found themselves 20 years ago; they are only beginning to realize their community of interest with each other and with other process industries. And secondly, although chemical engineering has evolved only recently from the still comparatively young science of chemistry, food preparation is almost as old as the human race. It is evident that the manufacture and preparation of food is a very ancient art and that the old quotation that "science has not yet caught up with art" probably is truer in the food industry than in any other, with the possible exception of agriculture. Because food manufacture is still largely art, the men at the top include very few with technical training. They have little or no appreciation of what chemical engineering can do for them. Those men who know most about the business are the ones who have grown up with it from the very bottom, while technical men usually have gone into the laboratories, and there most of them have stayed. Unless the man with scientific training has started at the bottom, the food manufacturer is not inclined to recognize him as a person of importance until something goes wrong, when art has to call on science in order to get out of difficulties.

The facts I have just mentioned do not constitute a defense for art in its stand against science. Rather, they are a challenge to the advance of art, and more particularly to the chemical engineer. Ample opportunity awaits him in the food industry, but it is opportunity which he must assist in creating for himself. Technical progress is being made in food manufacture at an accelerated rate,

and recognition of the scientific approach is growing apace. We may perceive the truth of this statement in a brief examination of some of the technical developments that have been brought about during recent years.

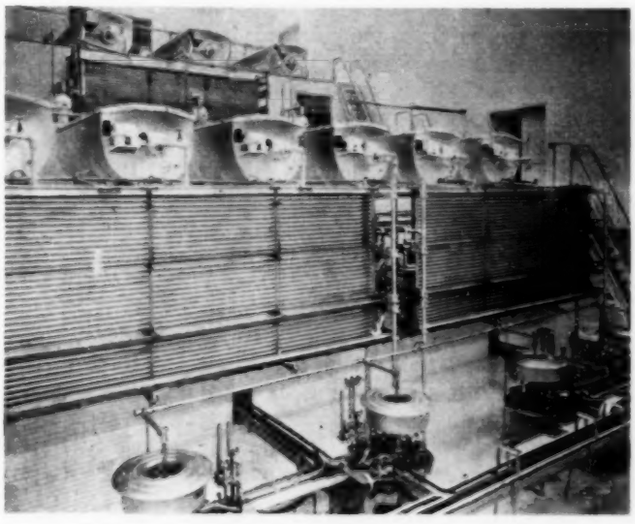
Pasteurization

One of the greatest influences for good and for the greater development of the dairy industry has been the stringent health regulations imposed on the producers and distributors of fluid milk. Although the industry felt that it was being done to death when such regulations were first imposed, pasteurization has not only fulfilled its purpose of rendering milk safe from possible inoculation with tuberculosis germs but it has also had the secondary effect of destroying many of the lactic acid bacteria and improving the keeping qualities of milk. Because of this, I question whether any modern dairyman with a technical understanding of his business would give up pasteurization now, even if he were permitted to do so.

Pasteurization consists in holding milk at a temperature of 145 deg. F. for 30 min. Originally it was accomplished at a higher temperature, in the flash pasteurizer, in which the milk was given a momentary or flash heat of about 160 deg. and then cooled. On account of secondary chemical reactions which take place in the milk, the flash-heating process is not now viewed with favor by most dairymen. Since it tends to destroy the cream line, the more recent holder type of pasteurizer is in much greater favor. In this process milk may be elevated to a temperature of 145 or 146 deg. and then held in insulated tanks or insulated pipes for a period of 30 min., after which it is cooled immediately. Rapid cooling after the 30 min. holding is very important, for every minute beyond that time means a corresponding loss in cream line and modification of flavor. These facts have necessitated the development of extremely efficient heat exchangers and temperature-control systems.

Obviously, were it not for these heat exchangers, the heat required in raising the temperature of an enormous quantity of milk from about 36 deg. to 145 deg. F. would be a very serious item of cost. And since very close adherence to the pasteurizing temperature must be maintained to avoid a poor cream line and a cooked taste, efficient heat exchange and temperature control are of utmost importance. During the last two or three years, heat exchangers for the dairy industry have been developed with which it is possible to heat milk to a temperature of 145½ deg. F., using a heating medium only about 1½ deg. hotter than the outgoing milk. This has been accomplished through two-stage heat exchange and temperature control equipment, in the development of which unfortunately, chemical engineers did not play an important part.

Batch Pasteurizers in a Modern Dairy



A recent development of considerable interest is that of electrical pasteurization, under the Electropure process, in which a column of milk serves as a resistance to the passage of an alternating electric current. Heating is very rapid—in fact it might be called electrical flash pasteurization—and the process has the advantage of preventing contact of the milk with hot surfaces, the electrodes themselves being water-cooled.

Not only milk and other liquids are being pasteurized, however, for its use has been extended to solid materials, notably, cheese, dates, and other dried fruits. In the case of dates, not only has there been an improvement from the public health aspect but the leveling off of production schedules has been of extreme importance. Before the introduction of pasteurization, it was necessary to process and package all of the dried fruit immediately upon its receipt from the Orient. With pasteurization, packaging and processing operations may take place uniformly throughout the year.

Canning

Although the art of canning foods—that is, sealing them hermetically in containers and sterilizing by heat—dates back about 110 years, it has become a science only within the last few years. Many canners are clinging steadfastly to the ways they learned in their youth, but the more progressive members of the industry are employing every device that is available to produce high quality. This becomes imperative in 1931 as the McNary-Mapes amendment to the federal food law becomes effective for various products.

One of the most important questions in canning is the matter of heat penetration. Its principles have recently been reduced to a mathematical formula, from which it is possible to figure in advance the proper processes necessary for canned food. Why heat penetration is of so much importance may readily be gaged from the fact that the canner is between two horns of a dilemma: to have his product merchantable, it must be as nearly raw as possible; but to avoid all possibility of spoilage, the product must be thoroughly sterilized. The action of heat, unfortunately, is not selective, and while the product is being sterilized it is also being cooked. Products which are on the acid side of neutrality permit comparatively easy sterilization, but those in which the pH is approximately 7 require markedly increased time and temperature in processing. If the rate of heat penetration is slow, due to the physical character of the contents of the can, there is considerable danger of overcooking. Slow penetration also increases the possibility of spoilage.

Another chemical-engineering problem of the canning industry is discoloration of the can contents. In some cases it is being found that proper adjustment of the pH avoids almost all the blackening which is a characteristic of certain products. Other products, which may evolve hydrogen sulphide during processing, have been found in some cases to turn black through the formation of iron sulphide by reaction with the metal of the can. In the older type of can with a soldered cover, this blackening never occurred. When automatic machinery required the use of a crimped can, instead of the earlier soldered one, this difficulty began to attract notice. It was found that

a very small quantity of the zinc chloride flux used in soldering the older can crept through the seams to the inside, and that this was sufficient to react with the hydrogen sulphide and prevent the formation of any of the black iron sulphide. The final solution of the problem, so far as the crimped can is concerned, has been found to lie in the use of an insoluble enamel containing a small quantity of zinc oxide. I believe that many further possibilities are still ahead of the canner, through the use of better interior enamels.

Homogenization

Recent years have seen the acceptance of the colloid mill and the homogenizer by a considerable part of the food industry. Mayonnaise manufacture is an important case where the use of such equipment has resulted in emulsions which will withstand rigors of treatment that were believed to be impossible even five years ago. The ice-cream industry has made use of the homogenizer for many years in bringing about a fine dispersion of fat globules to improve texture and overrun. The homogenizer is used also to disperse cocoa powder in chocolate drinks, for without proper dispersion the drink shows a marked separation of the cocoa powder, which is rather unsightly.

A very recent application of colloid mills and homogenizers is in the manufacture of tomato juice and tomato-juice cocktails. Without special treatment, the solids will separate, but with homogenization at 2,000 or 3,000 lb. per sq.in., a permanent suspension results.

Quick Freezing

One of the most interesting recent developments in food processing is the widely discussed subject of quick-freezing. To some people, quick-freezing seems a sort of magic, but it should be noted that it is neither magical nor new. It dates back to the time of the Civil War, but has had a remarkable revival in the last three or four years. This revival was initiated by the fishing industry, but it has now been taken up by the manufacturers of meats, milk, fruit juices, fruits, and vegetables. Quick-freezing is a very useful operation, but it seems to me there is great danger that it may be over-exploited. Except for the fact that the method minimizes the damage to food tissues done by the freezing, the rapidity of the operation has very little to commend it, and since comparatively little is known about the penetration of cold, those industries which are now springing up, based on freezing as a method of preservation, are sadly in need of definite scientific principles for their guidance.

As a result of the development of quick-freezing, we now see a new trend in the food industry toward packaged, perishable goods. Fish products took the lead in this respect, and were quickly followed by frozen, packaged cuts of meat. Another perishable product now being sold in packaged form is orange juice, which had its first large development in the winter just past. Other frozen, packaged products will come, the most important of which probably will be packaged frozen milk and cream. When this time comes, there will be an interesting problem for the colloid chemist in insuring a product which will not show a precipitate of globulin or separation of butter fat after freezing.

Fumigation

One of the chief difficulties of manufacturers of non-sterile foods, such as flour, breakfast foods, nuts, dried fruit, and similar products, was formerly infestation by insect pests. Two forms of control are now available to the manufacturer. He can fumigate his plant and get rid of all the insects for a short time, or he can fumigate the product and rid it of insects, after which he can package it in insect-proof containers. Fumigation has required much research to determine the proper fumigant for food. The most effective fumigant available is hydrocyanic acid, but it is hazardous even when carefully used, because of the fact that it is absorbed in moisture to a fairly high degree. Other fumigants, such as carbon bisulphide, are coming into use, and a new one was recently discovered by the U. S. Department of Agriculture. It is ethylene oxide, which is very effective in small concentrations, is reasonably cheap, and is not injurious to human beings and larger animals. Like carbon bisulphide, however, it is flammable, and in use must ordinarily be mixed with carbon dioxide. Commercial fumigation of food usually is carried out by the vacuum method. A vacuum is used to draw air from the material being treated whereupon the fumigant is introduced into the tank and penetrates to all parts of the material being treated. After about an hour or more, the poisonous gas is removed by evacuation, after which it is replaced with air.

Enzyme and Vitamin Control

Recent interesting developments in two of the more abstruse aspects of food manufacture are worthy of comment here. One of these concerns the preservation of orange juice. The freezing operation, already mentioned, is not the only important one in its preparation. De-aeration of the juice is equally important, because of the existence of oxidases or oxidative enzymes in fresh orange juice. These bring about rapid deterioration of the juice when exposed to air. One of the recently developed systems of freezing orange juice includes spraying it into a vacuum in order to release the dissolved air, and then freezing the juice under high vacuum in a freezing machine much like an ice-cream freezer. Since the enzymes cannot be destroyed by heat without injuring the flavor of the juice, it is necessary to remove the oxygen to avoid deterioration.

Great popular interest in the vitamin content of food has recently agitated this country. The value of vitamin incorporation cannot be debated here. However, the process is being employed to a large extent and hence has a commercial as well as a nutritional aspect. One of the simplest ways of supplying vitamins is to make use of a commercial concentrate of cod-liver oil. The well-known Steenbock method makes use of irradiation with ultra-violet rays by passing the product on a belt under the light from quartz mercury arc lamps. Recent work of Sperti and his associates at the University of Cincinnati seems to show that certain individual wave lengths of light in the ultra-violet region are those that produce the chemical changes in which we are most interested from the vitamin standpoint. This subject, however, is still too new for further discussion here.

This rather brief outline probably has only touched the high spots of recent chemical and chemical-engineering development in food processing. However, it should suffice to show that the food industry, while far from being virgin territory for the scientist as such, is still a field that should hold much attraction for the chemical engineer. With a grounding in physiological chemistry and bacterial physiology chemical engineers should not find it an insuperable difficulty to make a place for themselves in an industry which obviously has need for their services.

Plastic Products and Producers

The rise of industries manufacturing the various chemical products designated as plastics has in late years been attended by considerable vague eloquence and spirited prophecy. But while only a few of the products have ever reached plant-scale manufacture, when measured against other chemicals, they are all such typical products of chemical synthesis that *Chem. & Met.* has repeatedly stressed their technologic significance.

Meanwhile the trade name has so far usurped the place of the generic designation in the industry itself that technical orientation becomes a trying feat. The ensuing "directory," it is evident, seeks primarily to answer the questions that immediately surround the trade name in the engineer's mind: What is it? In what form is it obtainable? Who makes it?

In fairness to the user and contributor of this compilation, it should be emphasized that the items were compiled over a long span of time, with only human means available. Thus it is quite conceivable that some compounds listed have, since then, forever disappeared; that company names have become changed or absorbed; that actual misinformation has not been detected; and that significant names have escaped attention. Because, in these cases, proper notification has been wanting, any corrective comments from readers of this list are heartily encouraged.

This exacting compilation has been entirely the work of A. F. Randolph, of the chemical department, du Pont Viscoloid Co., Arlington, N. J., to whom *Chem. & Met.* feels thankful not only for introducing order into the confusing data but especially for making them available here.

Descriptive Code and Abbreviations

(Rubber, rayons, and artificial leathers are not covered).

B	Inorganic	Px	Pyroxylin
C	Casein	SG	Safety glass
CA	Cellulose Acetate	UF	Urea-formaldehyde
D	Resin used as ingredient	V	Viscose
F	Fabricator's trade name	W	Wood Fiber
P	Packaging material	X	Miscellaneous
PF	Phenol-formaldehyde	?	Nature not known

f forms: sheets, rods, etc.
l laminated board, etc.
m molding compound
s soluble for varnish, impregnation, etc.
t turnery type (not moldable); articles made by casting and machining.

Blücher—"Plastische Massen", by Hans Blücher, Salomon Hirzel, Leipzig, 1924.
Brit. Plast.—British Plastics and Moulded Products Trader, London.
CGP—Le Caoutchouc et la Gutta-Percha 49, rue des Vinaigriers, Paris.
Cellulose—Cellulose Pub. Co., 114 E. 32d St., New York.

Gummi-Ztg.—Gummi-Zeitung, Krausenstr. 35, Berlin.
GZB—Warennamen-Verzeichnis, Beilage zur Gummi-Ztg.
Hemming—"Plastics and Molded Electrical Insulation", Emile Hemming, Chemical Catalog Co., New York, 1923.
Kunstst—Kunststoffe, J. F. Lehmanns, München, Germany.
Nitrocellulose—Verlag Pansegrau, Berlin—Wilmersdorf.
Plastics—Plastics and Molded Products, 114 E. 32 St., New York.
Rev. Gen. Mat. Plast.—Revue générale des matieres plastiques, 29, rue Turgot, Paris.

Name	Description	Manufacturer or Reference
Abalak	PF, s, Varnish resins	Kunstharzfabrik Dr. Fritz Pollack, Vienna.
Ace-Ite	CA	American Hard Rubber Co., Butler, N.J.
Acéloid	CA	Cie. Petit-Collin-Oyonnithe, Paris.
Acelose	CA	American Cellulose Co., Indianapolis, Ind.
Acéta	CA	Cie. Petit-Collin-Oyonnithe, Paris.
Acetaloid	CA, m	Acetate Products Corp. Ltd., London.
Acetex	CA, SG	England—(**Chem. Trade J. 85**, 396, 1929).
Acetoid	CA	Punfield & Barstow, Ltd., London.
Acetol	CA	Soc. Usines Rhone-Poulenc, Paris.
Acrolite	X, m, l, Phenol-glycerine	Continental-Diamond Fibre Co., Newark, Del.
Ad-Triplex	Px, SG, With Lithogr.	Triplex Safety Glass Co. of N. A., Clifton, N. J.
Aevolit	(See Haefelyte).	
Agatine	PF, t, Rods	Société Nobel Francaise, London.
Agfa-Viscose	Sponge	I. G. Farbenindustrie, Berlin.
Aico	X, Cold molding	American Insulator Corp., New Freedom, Pa.
Akalit	(See Akelit).	
Akalith	(See Akelit).	
Akelit	C	Akelit Kunsthorn-Werke, Vienna.
Aladdinite	C. f.	Aladdinite Co. Inc., Orange, N. J.
Alberit	?	Scott Bader & Co., London.
Albertol	PF, m, s, t	Chem. Fabriken Dr. Kurt Albert Wiesbaden, Germany.
Albolit	PF, t	Röhm & Haas, Philadelphia, Pa. Augsburger Kunstharz-Fabrik, Augsburg, Germany.
Alboresin	UF, m	Kontakt—Römmler AG., Frankfurt.
Aldur	UF, m	Aldur Corp., Brooklyn, N. Y.
Aldydale	PF,? Blocks, molded articles, etc.	I. G. Farbenindustrie A. G. Frankfurt, Germany.
Algalith	C	deCharrard, Rueil, France.
Alino	Px, F	R. Strauss & Co., Frankfurt, Ger.
Alkalith	C	(**Gummi—Ztg. 45**, 935, 1931).
Amberol	(See Albertol).	
Ambra	PF, Clear solid	(**Plastics 4**, 263, 1928).
Ambrasit	PF, t	Chemische Fabrik Ambrasit, Vienna.
Ambroid	X, Pressed amber	(Blücher, 188).
Ambroine	X, f	Soc. Grandgener, Perreux, France.
Amerith	Px, f	Celluloid Corp., Newark, N. J.
Amiantine	PF,?	Soc. Roux, Paris.
Amzylolithe	CA	Soc. Lyonnaise de Celluloide, Lyons, France.
Annalith B	Gypsum plastic	(Blücher).
Annealogic	X, Ins. mat. (bitumen etc.)	Telegraph Const. & Mntnce. Co., London.
Ardenite	PF, ?. m, Synthetic resin molding powder	F. G. Stokes, Ltd., Altrincham, Eng.
Argolit	C	Argo Chem. u. Nahrungsmittel Fabrik, Prerov, Czechosl.
Artriplex	Px, SG, With colored plastic	Triplex Safety Glass Co. of N. A., Clifton, N. J.
Astra	F	Spritzgiessereien Haslinger & Pesse, Vienna.
Athrombit	Px, F	F & M Lautenschlaeger, München, Ger.
Atlastik	Px, F	Atlas Ago Chem. Fab. A. G., Mölkau, Leipzig, Ger.
Axolith	C	Soc. Oyonnaxienne, Oyonnax, France.
A Winto	Px, F	Adolf Winter, Ober-Esslingen, Ger.
Bakdura	PF	(**Plastics, 6**, 705, 1930).
Bakelaque	PF, l	Attwater & Sons, Preston, Eng.
Bakelite	PF, m, l, t, s	Bakelite Corp., New York.
Balenit	X, Shellac base	(**Kunstst, 10**, 110, 1920).
Bandalasta	UF, F	Brooke & Adams, Ltd., England.
Basselon	F, Ware	C. Basse & Cie., Lüdenscheid, Ger.
BCM/ Brownie	F, Ware	Brownie Wireless Co., London.
Beacon	UF, F, Ware	(Made of Beetle powder).
Beatl	UF, F, Ware	Beatl Sales, Ltd., England.
Beckacite	?, Synth resin	A. F. Suter & Co., England.
Beck-O-Lac	D	Beck, Koller & Co., Detroit.
Beerit	B, Water glass and mineral fillers	(Blücher 266).
Beetle	UF, m	Beetle Products Co. Ltd., Worcestershire, Eng.; Synthetic Plastics Co. Inc., New York.
Beetleware	UF, F, From Beetle	Beetleware Corp., New York.
Beiling-Lee	C, F	Beiling & Lee, Ltd., Middlesex, Eng
Bennetate	CA	B. A. Parker, London.
Bernit	CA	Zelluloidwaren Fabrik, Zollikofen, Switzerland.
Bexite	F	British Xylonite Co., Ltd., London.
Bexoid	CA, ?, "Safety celluloid"	British Xylonite Co. Ltd., London.
Bikarton	PF	(**Plastics 6**, 705, 1930).
Bincolithe	X, m, Resorcinol, trioxymethylene	German General Elec. Co. Berlin.
Birmite	UF, F, From Beetle	E. Elliott, Birmingham, Eng.
Bituba	PF	(**Plastics, 6**, 705, 1930).
Boschbakelit	PF	Germany, (**Plastics, 6**, 705, 1930).
Braylite	?	American Insulater Corp., New Freedom, Pa.
Britsulite	PF, m	British Insulite Ltd., Rochdale, Eng.
Brofo	X, Coumarone resin	Brown & Forth, Ltd., London.
Brolon-kapseln	V, P, Closures	
Butaceta	F	I. G. Farbenindustrie, Frankfurt, Ger.
Campbellite	PF, l	Campbell Fibre Co., Stanton, Del.
Capes Viscose	V, P, Closures	du Pont Cellophane Co., Dellawanna, N. J.
Carbolite	PF, ?	Soc. Ind. des Matieres Plastiques, Fr.
Carboloid	PF, m	Carboloid Products Corp., New York.
Carnoid	C	Cie. Générale d'Electricité, France.

Name	Description	Manufacturer or Reference
Carta	PF, Impr. paper	Isola-Werke A. G., Düren, Germany
Cascaphane	Px, F, Closures	Cascaloid, Ltd., Leicester, England.
Caseilithe	C	Soc. Ind. du Celluloïde, Paris.
Casein Durville	C	Cie. Générale d'Electricité, France.
Casoide	C	(**Plastics, 2**, 123, 1926).
Casolith	C	L. M. Mears & Co., London.
Cassoid	C	Maison Blanpain, Esy, France.
Catalin	PF, t	American Catalin Corp., New York.
Celerite	?	Cie. Générale d'Electricité, France.
Celanese	CA, m	Celanese Corp., New York.
Celastic	Px, F, Boxtoe material	Celastic Corp., Arlington, N. J.
Celastoid	CA, f	British Celanese Ltd., London.
Celescot	Px, m	Celescot Co., Toledo, Ohio.
Celiabutol	Px, F	I. G. Farbenindustrie, Frankfurt, Ger.
Celiastine	CA, m, f	British Celanese, Ltd., London.
Celilemit	CA	Europe (Blücher 153).
Celiesta	Px	Verein f. Chem. Industrie, Frankfurt, Germany.
Cellit	CA, Acetyl cellulose	Farbenfabriken Fried. Bayer, Leverkusen, Ger.
Cellobase	Px, CA, V, F	Raymond Boisdé, Paris.
Cellon	CA, f	Deutsche Celluloïd Fabrik, Eilenburg, Germany.
Cellophan	V, P	I. G. Farbenindustrie, A. G., Frankfurt, Germany
Cellophane	V, P	Soc. la Cellophane, Paris; du Pont Cellophane Co., Buffalo, N. Y.
Celliosite	CA, P, Acetylcellulose	Ettore Rossi, Milano, Italy.
Cellstop	P, Packing material	Norway (**Brit. Plast., 2**, 227, 1930).
Celluclaire	Px, P, Transparent wrapping	
Celluin	CA, f, m	Paul Rie & Sohn, Prag, Czechoslov.
Cellulit	C	Soc. Ind. du Celluloïde, Paris.
Cellulith	W, Sulphite pulp plastic	H. Brunswig (USP 622, 325).
Celluloid	Px, f	Celluloid Corp., Newark, N. J.
Celluloid de Socker	(See Celluloid Lehmann).	
Celluloid Lehmann	Waxes, starch, casein, etc.	
Cellutite	CA	G. Convert & Cie., Paris.
Celluvert	C	Soc. Ind. du Celluloïd, France.
Cel-O-Glass	CA, Coated netting	Acetol Products, Inc., New York, N.Y.
Celoron	PF, m, l	Continental-Diamond Fibre Co., Bridgeport, Pa.
Celotex	W, Board from Bagasse	Celotex Co., Chicago.
Celtid	Px, f	Rhein. Gummi u. Celluloïd Fabrik, Mannheim, Ger.
Cerite	Pf, s	Clement & Riviere, Paris.
Cervinite	CA	Zelluloidwaren Fabrik, Zollikofen, Switz.
Cetec	X, Cold molded	General Elec. Co., Meriden, Conn.
C. F. Board	PF, l	Campbell Fibre Co., Stanton, Del.
Ciba	UF, ?, Molding powder	Soc. Chem. Ind., Basel, (Ciba Co., Inc., New York City).
Cilkloid	Px, Surgical wrapping	U. S. A.
Cinelin	Px, CA, (Refined film scrap)	Cinelin Co., Indianapolis, Ind.
Claudilithe	C	(**Plastics, 2**, 396, 1926).
Clubman	CA, F	A. W. Kanis, London.
Colasta	X, m, Sulphonated oil; formaldehyde	Colasta Co., Inc., Hoosick Falls, N.Y.
Coltrock, Coltstone	PF, Cold-molding compounds. X, Cold-molding compounds.	Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.
Concordia	F ,Molded products	Concordia Elec. Safety Lamp Co., Cardiff, Wales.
Condensite	PF, m,	Bakelite Corp., N.Y., and Europe.
Coralex	PF	Soc. Francaise, Vitry, France.
Cornit	W, Pressed paper	(Blücher).
Corozite	C	Soc. Anon. Prodotti Corozite, Goriago, Italy.
Crayonne	CA, ?, m	A. W. Kanis, London.
Craypax	P, "Elastic" waxed paper	Waxed-Bags, Ltd., London.
Cristalux	CA, Sheeting	Acetate Products Corp., Ltd., London.
Cristalyx	UF	Edgard Israel, France.
Cristore	CA, ?, Sheeting	Speights Ltd., England.
Crommoid, Cromware	F, Ware from synth. resin	Cromwells, Ltd., Staffordshire, Eng.
Crystalate	F, Molded goods	Crystalate Gramophone Record Co., Kent, England.
Crystalite	UF	Röhm & Hass, Philadelphia, Pa.
Crystallone	F, Cut glass limitation	Paul Schlochoff, Paris.
Crystillin	PF, t	Crystillin Products Corp., Bklyn, N.Y.
Crystur	UF, t	Panplastics, Heyden Chemical Co., Garfield, N. J.
Curvitas	F, CA, ?	A. W. Kanis, London.
Dako	?, Molding powders	Commercial Utilities Ltd., London.
Damarda	PF, s, Metal coating	Bakelite Ltd., London.
Decosan	?	Shanks & Co., Renfrewshire, Eng.
Dekorit	PF, t	Dr. F. Raschig G.m.b.H., Ludwigshafen, Ger.
Dilecto	PF, l	Continental-Diamond Fibre Co., Newark, Del.
Dobsoid	F, C	John Dobson, Ltd., Milnthorpe, Eng.
Dorcasine	C, Casein plastic	Charles Horner, Ltd., England.
Dorex	P, f	Dorex, Paris.
Dumold	Px, m,	du Pont Viscoloid Co., Arlington, N.J.
Duo-Lite	SG	Pittsburgh Plate Glass Co., Pitts., Pa.
Duosine	F, Transp. advertisements	W. & G. Baird, Ltd., England.
Duplate	SG, Px,	Pittsburgh Plate Glass Co., Pitts., Pa.
Duranoid	PF, With shellac	Specialty Mfg. Co., Hoosick Falls, N.Y.
Durax	PF	Isola-Werke, Düren, Germany.
Durez	PF, m, f, l, s	General Plastics, Inc., North Tonawanda, N. Y.
Durite	PF, m, f, l, s	Stokes & Smith Co., Philadelphia, Pa.
Durium	PF, s, resin, records	Durium Products Corp., New York.
Durold	PF	Bakelite Co., France.
Durolit	PF, t	Soc. du Durold, Enghien, France.
Durophene	D, Resins for mold. powders, etc.	Scott Bader & Co., London.
Duroware	UF, F, Ware from Beetle	U. S. A.
Ebonestos	F	Ebonestos Insulators, Ltd., London.
Eburin	X, Hot molding	(Hemming 179).
Elastolith	PF, t	Herold A. G., Hamburg.
Electrobestos	X, Cold molding	(Hemming 179).
Electroine, Electrolit		Etablissements Grivolas, Paris.
Electrose	X, Hot molding	Insulator Mfg. Co., Bklyn, N. Y.
Ellinol	F	Ellison Insulations, Ltd., Birmingham, Eng.
Elimar	F	Elimar Mouldings Co., Birmingham, Eng.
Elo	PF, s, m	Birkby's, Liversedge, Yorkshire, Eng.
Emür	Px, F	Eberhard Müller, Remscheid, Ger.
Endura	UF, F, Ware from Beetle	(**Plastics 3**, 605, 1927).
Eolit	PF, t, Former name for Juvelith	
Ergolith	C	McLeod & McLeod, London.
Erinoid	C, f	Erinoid Co., New York.
Ernolith	C, Yeast-aldehyde	Blücher & Krause, Leipzig, Germany.
Esbrilith	C, f	Rheinisches Farbwerk, Berlin.
Eshalite	?, Molding compounds	Siemens-Schuckert Werke A.G., Berlin, (**Plastic 6**, 705, 1930).
Estralit	PF	
Faturan	PF, t	Dr. Heinrich Traun u. Söhne, Hamburg
Fabroil	PF, l (Gears)	General Elec. Co., Schenectady, N. Y.
Fabrolite	PF, m	Commercial Utilities, Ltd., London.
Fantasit	?, "Synthetic Horn"	Rhein.-Westf. Sprengstoff A. G. Troisdorf, Germany.
Fermit	?, m	**Gummi-Ztg., 45**, 1010, 1931).
Ferrozel	PF, ?, l	Deutsche Ferrozell Ges. Augsburg, Ger.
Fiberloid	Px, f	Fiberloid Corp., Indian Orchard, Mass.
Fimielite	PF	Italy, (**Plastics 6**, 587, 1930).
Firmoid	F, Px, CA, Coating	Bluemel Bros., Ltd., Wolston, England.
Foord'sCasein Plastic	C, (Pulverized coconut shells —	K_4SiO_4)
Formalite	PF	Bakelite, Ltd., Greet, England
Formica	PF, l	Bakelite Corp., New York.
Formite	PF, t	Bakelite, Ltd., Greet, England.
Formolit	X	Alexander M. Nastukoff, Moscow.
Formolit	?, Molding powder	Hamburger Gummi Waren Compagnie Hamburg (and New York).
Futurit	?	Kabelfabrik u. Draht Industrie, Vienna
Galakerite	C	Soc. Ital. Galakerite, Milano.
Galalith, Galapol	C, f, s	Internationale Galalith Ges., Harburg, Germany.
Galatix	C, F	Lumos & Co., London.
Gansolite	?	Gansolite, Ltd., Nijkerk, Holland.
Gaudafil	V, P	(U. S. P. 1,688,457).
Geloid	X, Gelatine plastic	Germany.
Gesundheits-Pass	Px, F	Braun & Co., Berlin.
Glider	F, CA, ?, Molded	A. W. Kanis, London
Globerite	C	Soc. Ind. Globerite, Milano.
Glorit	C	Schiel u. Spol, Sternberg, Czechoslov.
Glyptal	X, Glycerol-phthalic anhydride	General Elec. Co., Schenectady, N. Y.
Glyptanite	X, Glyptal bonded mica	Micanite & Insulators Co., Walthamstow, England.
Gummon	PF, m, Cold-Mold compound	Rhein.-Westf. Sprengstoff A. G., Troisdorf, Germany.
Haefelyte	C, PF, t	Emil Haefely & Cie., Basel, Switz.
Hagolit	CA, ?	Gebr. Eckert, Nürnberg, Germany.
Hal-Ho	Px, F	Hainich-Holz, G.m.b.H., Langensalza, Germany.
Halex	?, Ware	British Xylonite Co., London.
Halizite	PF, W	Halizite Corp., New York.
Hares, Haresit, Harex	PF, m, PF, s, PF, l	Römmler A. G., Spremberg, Germany.
Harlequin	UF, F, (From Beetle)	England.
Hastra	C	Hastra Kunstharz-Presswerk, Vienna
Haveg	PF, m, t	Saeureschutz Gesellschaft, Berlin.
Hecolite	Px	Heko-Werke, Berlin.
Hekolith	Px	Heko-Werke, Berlin.
Heliosit	PF, ?, Insulating resins	Kontakt-Römmler A. G., Frankfurt, Germany.
Helinzell	V, P	(**Nitrocellulose, 1**, 161, 1930).
Herculite	X, m	Colasta Co., Hoosick Falls, N. Y.
Herkolite	?	General Elec. Co., Schenectady, N. Y.
Herolith	PF, t	Herold, A. G., Hamburg, Germany.
Hightensite	?	Hightensite, Ltd., (**Brit. Plastics, 2**, 280, 1930).
Hornit	C	Gottfried Probst, Nürnberg, Germany.
Hyalin	Px	
Hycoloid	Px, CA, Tubes, bottles	Hygienic Tube & Container Co. (U.S.A.)
Hyli	Px, F, Ware	Hygienische Ind., Ostertag, Ludwigsburg, Germany.
I. C. I. Moulding Powders	PF, m	Imperial Chem. Indus., Ltd., London.
Idelite	PF	Bakelite Ltd., London
Inda	C, f	American Machine & Foundry Co., Brooklyn, N. Y.
Indestructo	SG, Px	Indestructo Glass Corp., Farmingdale, N. Y.
Indurite	PF, m	"Indurite" Sales Ltd., London.
Infuselax	UF, Lacquer	Beetle Products Co., London.

Name	Description	Manufacturer or Reference
Inlite	X, f	Inland Mfg. Co., Dayton, O.
Inodite	(See Ondoita).	
Insulate	X, Hot molding	Insulation Mfg. Co., Brooklyn, N. Y.
Insulit	W, Board	Backus-Brooks Co., U. S. A.
Insuloid	CA, P, Sheeting	Harold Levey, New Orleans, La.
Isogalithe	C	Garraud, Tailleburg, France.
Isolemite	B, Talc & Magnesium silicate	
Isolid	PF	Soc. Francaise, Vitry, France.
Isolierstahl	PF	(**Plastics, 6,** 705, 1930).
Isolithe	PF, ?	Soc. Beguin, Paris.
Isoloid	CA	Charles Martin, Levallois, France.
Isophan	P, Ethyl cellulose	Cellonwerke, Charlottenburg, Ger.
Ivaleur	Px, F	Celluloid Corp., Newark, N. J.
Ivoirine	X, Gelatine base	
Ivoit	PF t	Kunstharzfabrik, Dr. Fritz Pollak, Vienna.
Ivorax	PF, t	Herold, A. G. Hamburg.
Ivory Cross	F, CA, ?, Molded articles	A. W. Kanis, London.
Ivrite	PF	Soc. Anon. Ivra, Turino, Italy.
Ixolain	PF, For dentures	Dr. Hick, Eng., (**Plastics, 3,** 552, 1927).
Jarax	PF, l	Jaroslaw's Glimmer-Waren-Fabrik, Berlin.
J M S	X, F	JMS, G.m.b.H., Hamburg.
Joanite	PF, t	Joanite Co., Brooklyn, N. Y.
Jurid	?, m, Asbestos filler	Kirchbach, Germany.
Juvelith	PF, t	Kunstharzfabrik Dr. Fritz Pollak, Vienna.
Karben	(See Kupren).	
Karbolite	PF (with naphtha sulphonic acids)	Petroff (inventor), (**Plastics, 2,** 391, 436, 1926).
Karolith	C, f, m	American Plasties Corp., New York.
Kasinoid	C, ?, F	A. W. Kanis, London.
Kelacoma	UF, f, m	Kelacoma Ltd., Welwyn Garden City, N. Y.
Kellite	PF	Kellogg Switchboard & Supply Co., Chicago.
Kerasolith	?	Keramchemie Berggarten, Giessen, Ger.
Kerit	C, ?, F	Internationale Galalith Ges., Harburg, Germany.
Keronyx	C	Aberdeen Combworks Co., Ltd.
Kinonglas	SG, Px	N. Kinon, Aachen, Germany.
Kodaloid	Px, Film	Eastman Kodak Co., Rochester, N. Y.
Kopan	PF, m, s	Kunstharzfabrik Dr. Fritz Pollak, Vienna.
Koraton	PF, t	Wedig & Reuss, Ellenburg, Germany.
Kupren	?	Elektrizitaetswerke Lonza, Basel, Switzerland.
Kyloid	C	Kyloid Co., Muskegon, Mich.
Lacanite	PF	American Record Corp., Scranton, Pa.
Laccain	PF	Louis Blumer, Zwickau, Germany.
Lacrinoid	F, "Artificial horn"	Lacrinoid Products, Ltd., London.
Lactilith	C, f	Charles C. Fitzroy, London.
Lactite	C (Hydrated casein, alum, borax, starch)	
Lactitis	C, Metallic caseinate	
Lactoid	C	British Xylonite Co., England.
Lactoite	C, Px	France.
Lactolithe	C, f	Glogau et Cie., Vitry, France.
Lactonite	C, f	British Lactonite Co., London.
Laculose H	X, Glyc.-phthal. anhyd	Grindley & Co., London.
Laminol	PF, l	Ellison Insulations, Ltd., Birmingham England.
Lennite	PF, m, For dentures	Ohio Chemical & Mfg. Co., Clevel'd, O.
Leukorit	PF, t	Dr. F. Raschig, G.m.b.H., Ludwigshafen, Germany.
Lewisol	D, Lacquer gums	John D. Lewis, Providence, R. I.
Lignat	W, Organic fibers & binder	Christof & Unmack, A. G., Oberlausitz, Germany.
Linga-Longa	UF, F (From Beetle)	Beatl Sales Co., London.
Linolin	?, Insulation	Lindsay & Williams Ltd., Manchester, England.
Lithene	CA, m	Plastic Moulding Co., Ltd., London.
Lonarit	CA, m	Lonarit-Ges., Berlin-Schöneberg.
Lorival	?, f	Lorival Mfg. Co. Ltd., Southall, Eng.
Lor-Wal-Lith	PF, t	Chemie u. Technik JMS, G.m.b.H., Hamburg.
Lucite	Px, f	du Pont Viscoloid Co., Arlington, N. J.
Luglas	SG	Röhm & Haas, A. G., Darmstadt, Ger.
Lumarith	CA, m	Celluloid Corp., Newark, N. J.
Lupinite	C	Germany (**Plastics, 3,** 674, 1927).
Luxalin	Px	(See Pyradiolin).
Luxalith **Luxolith**	C	Soc. l'Oyonnaxienne, Oyonnax, France.
Macoid	Px, Dip finish	Crawford, MacGregor & Canby, Dayton, Ohio.
Magranit	PF, l	Australia.
Maizewood	W, Cornstalk board	(**Cellulose, 1,** 10, 1930).
Maizolith	W, Cornstalk plastic	(**Rev. Gen. Mat. Plast., 6,** 461, 1930)
Makalot	PF, s, m	Makalot Corp., Boston, Mass.
Makelite	P, Cellulose container substance	American Can Co., New York.
Mandem	F	McLeod & McLeod, London.
Manusolite	?, "Cellulose Plastic"	Soc. d'Isolants et Objets Moulés, Fr.
Marblene	CA, ?, Sheeting	Waite & Son, Ltd., England.
Marblette	PF, t	MarbletteCorp., Long Island City, N.Y.
Marbloid	CA, ?, Sheeting	Speights, Ltd., England.
Marbolith	PF, t	Herold A. G., Hamburg.
Marvelex	SG	England.
Masa	PF, f	Masa G.m.b.H., Berlin.
Masonite	W, Board	Mason Fibre Co., Laurel, Miss.
Masuron	CA, f, m	John W. Masury & Sons, Bklyn, N. Y.
M E C	CA, F, Molded articles	Minerva Engineering Co., London.
Megohmax **Megohmior** **Megohmit**	PF, ?, Insulation	John Moores & Co., Salford, Lancashire, England.
Metduro	PF, t	Metduro, Ltd., London.
Micafolium	PF	(**Plastics, 6,** 705, 1930).
Micanite	X, Laminated mica	John Moores & Co., Salford, England.
Micarta	PF, l	Westinghouse El. Co., Pittsburgh
Micolite	PF, m, Glutens and phenol	Paul Edgard Basset, Paris.
Midgema	F	Midland Gear Case Co. Ltd., Birmingham, England.
M. L.	UF, F, From Beetle	Beatl Sales Co., England.
Moldite	CA	American Cellulose & Chem. Mfg. Co., New York.
Monit	V, Viscose plastic	Europe. (**Gummi-Ztg., 45,** 1242, 1931).
Monolite	X, Hot-molding compound	Monowatt Electric Corp., New York.
Mouldenaite	PF, m	Demard Lacquer Co., Greet, England.
Mouldings of Merit	F	Insulators, Ltd., Edmonton, England.
Mouldrite	PF, m	Croydon Mouldrite, Ltd., Croydon, England.
Mowilith	D, Vinyl resin	Farbwerke Hoechst (I.G.), Germany.
Nacara	Px	Fiberloid Corp., Indian Orchard, Mass.
Nacrolaque	CA, Sheeting	Jos. H. Meyer Bros., Bklyn, N. Y.
Neolith	C	Deutsche Kunsthorn Gesellschaft, (**Gummi-Ztg., 45,** 935, 1931).
Neolith	PF	(**Plastics, 6,** 705, 1930).
Neophan	CA, P, Wrapping	Cellonwerke, Charlottenburg, Ger.
Neoresit	PF, s, m	Aug. Nowack A. G., Berlin.
Nestorite	PF, m, s, Molding powder and resins	James Ferguson & Sons, Ltd., Merton Abbey, London.
Neutex	SG, CA, Safety glass	Sicherheitsglas Neutex, Aachen, Ger.
Nevalyte	F	Myers, Ltd., Walthamstow, England.
Newtex	SG, CA	England.
Nie-Splitt	SG	Dewag Deutsche Warenvertriebs G.m.b.H., Berlin.
Nixonoid	Px, f	Nixon Nitration Works, Nixon, N. J.
Nobeline	PF, t	Soc. Nobel Francaise, London.
Norgine	X, Alginates (from seaweed)	(**Plastics, 6,** 656, 1930).
Norloc	F, m	Norton Labs. Co., Lockport, N. Y.
Noveltic	Px, F	K. F. Mayer, London.
Novolak	PF, s	Bakelite Corp., New York.
Novolithe	CA	Soc. Bellignite, Bellignat, France.
Novoresit	X, Resorcinol-trioxymethylene	Aug. Nowack, Gautzen, Germany.
Novotext	PF, Molded gears (fabric filled)	(**Plastics, 6,** 705, 1930).
Nuplax		American Nuplax Corp., New York.
Onazote	?, Heat insulation	(**Brit. Plastics, 2,** 242, 1930).
Ondoita	?	Afcom, Ltd., London.
Opal	PF, t, See Ivoit	
Opalax	CA, ?, Molding material	A. W. Kanis, London.
Orlak	PF, F	Chance Bros & Co., West Smethwick, England.
Ornalith	PF, t	Herold A. G., Hamburg.
Orolithe	C, a	Soc. l'Oyonnaxienne, Oyonnax, France.
Orthospan	CA, Sheets, etc.	Medical Supply Assn., Ltd., London.
Oxygalalith	C, Casein plastic	France.
Oyocetil	CA	Soc. l'Oyonnaxienne, Oyonnax, France
Oyogalithe	C	Soc. l'Oyonnaxienne, Oyonnax, France.
Oyonnithe	C	Soc. Petit-Collin-Oyonnithe, France.
Ozaphane		Le Film Ozaphane, Paris.
Panelyte	PF, l	Panelyte Co., Boston, Mass., Trenton, N. J.
Panolite	?	I. Paenson et Cie., Paris.
Pantolit	PF, t	Augsburger Kunsthars-Fabrik, Augsburg, Germany.
Papier Maché	W, Pressed paper	
Papyroplast	?	(**Brit. Plastics, 2,** 323, 1930).
Paralithe	D, ?, Turnery resin	Etablissements Kuhlmann, Paris.
Patentlack	D, "Hardenable Binder"	Louis Blumer, Zwickau, Germany.
Paxolin	PF	Micanite & Insulators Co., London.
Pearlite	CA, ?, Sheeting	Speights, Ltd., England.
Pearloid	Px, Sheeting	Joseph H. Meyer Bros., Bklyn., N. Y.
Peralit	PF, P	(**Plastics, 6,** 705, 1930).
Permacal	F, Adv. transparencies	W. & G. Baird Ltd., England.
Permanite	Px, F	Parker Pen Co., Janesville, Wis.
Pertinax	PF, l	Meirowsky & Co., Porz am Rhein, Ger.
Phenolic	PF, F	American Record Corp., Scranton, Pa.
Phenolite	PF, l	National Vulcanized Fibre Co., Wilmington, Del.
Philite	PF, m, cresol, phenol-formal	N. V. Philips Fabrieken, Eindhoven, Holland.
Phonycord	?, Record material	Phonycord, G.m.b.H., Berlin.
Picaroid	Px, Molding sheet around articles	Picaroid Process, Ltd., London.
Plaskon	UF, m	Toledo Scale Co., Toledo, Ohio.
Plass	UF, "Organic glass"	Pollopas, Ltd., Nottingham, England.
Plastacele	CA, f	du Pont Viscoloid Co., Arlington, N. J.
Plastam	?	Soc. Lilloise Plastom, Lille, France.
Plastico	?	(**Rev. Gen. Mat. Plast., 6,** 509, 1930).
Plastilume	CA, ?, F	W. V. Hutchinson, London.
Plastin	CA	Soc. des Matières Plastiques, Paris.
Plastine	CA, F	Soc. Nobel Francaise, Paris.
Plastose	PF	Afcom Ltd., London.
Plax	D (See Rucel)	Plax Products, Ltd., London.
Plexigum	D (Used in Lugias)	Röhm & Haas A. G., Darmstadt, Ger.
Plynalith	C, CA	Isaac Frenkel (agent), Paris.
Pollopas	UF, m, f	Kunstharzfabrik Dr. Fritz Pollak, Vienna.
Polyroc	?, Turnery resin	Etablissements Kuhlmann, Paris.

Name	Description	Manufacturer or Reference
Porcellanite	C	Soc. de Charraud, Ruel, France.
Press Mass	CA, m	American British Chemical Supplies, Inc., New York.
Pressmikanit	PF	(**Plastics, 6,** 705, 1930).
Presseil	PF	(**Plastics, 6,** 705, 1930).
Prima Linoleum	(See Triolin)	
Primalithe	C, f	Compagnie des Procédés Plinatus, Paris
Progilite	PF, m, s	Société Résines et Vernis Artificiels, Paris.
Prophopha	?	Produits "Prophopha," France.
Protectoid	CA, P	Celluloid Corp., Newark, N. J.
Proteolite	C	Ind. Italiana della Proteolite, Milano.
Prystal	UF, f	Soc. Industrielle des Matieres Plastiques, Paris.
Pyradiolin	Px, Sheeting	du Pont Viscoloid Co., Arlington, N.J.
Pyralin	Px, f	du Pont Viscoloid Co., Arlington, N.J.
Pyroplax	X, Cold-molding	Cutler-Hammer, Inc., Milwaukee, Wis.
Radite	Px, F	Sheaffer Pen Co., Ft. Madison, Iowa.
Redmanol	PF, m	Bakelite Corp., New York.
Reliance	Px, CA, F	Reliance (Nameplates) Ltd., Twickenham, England.
Repetit	PF	(**Plastics, 6,** 705, 1930).
Resan	P, f	Bakelite Corp., New York.
Resanit	PF, t	Kunstharzfabrik Resan, Mosbierbaum, Germany.
Resin, AH, AWI, AW3	X, Polymerized styrol	(**C. & G. P., 28,** 15366, 1931).
Resinit	PF, s, t	Knoll & Co., Ludwigshafen, Germany.
Resinol	PF, s, m	Dr. F. Raschig, G.m.b.H., Ludwigshafen, Germany.
Resinox	PF, s, m	Resinox Corp., Metuchen, N. J.
Resin Superba	PF	Italy, (**Plastics 5,** 38, 1929).
Resin Superbo	PF	Italy (**Plastics, 6,** 38, 1929).
Resistan	PF, Heat-resisting	Kontakt-Römmler A. G., Frankfurt, Germany.
Resopal	UF, m	Römmler A. G., Spremberg, Germany.
Reynolite	F	Reynolds Spring Co., Jackson, Mich.
Rezinel	D, Resins	Glyco Products Co., Inc., Bklyn, N. Y.
Rezyl	X, s, Glycernol-phthal. anhy.	American Cyanamid Co., New York.
Rhodialine, Rhodoid	CA, m, f	Soc. Usines Chimiques Rhone-Poulenc, Paris.
Richelain	UF, F, Ware	Richardson Co., Melrose Park. Ill.
Ricolit	?	Südd. Isolatorenwerke, Freiburg, Ger.
RJR	F, C, Molded articles	Afcom, Ltd., London
Roanoid	UF, F, From Beetle	Roanoid, Ltd., England.
Roburine	?, m	Soc. d'Isolants et Objects Moulés, Fr.
Rockite	PF, s, PF, m	Rockhard Resins Ltd., London.
Rockshell	PF, s, PF, m	Rockhard Resins Ltd., London.
Rollistic	F	Rolls Razor Co., London.
Ronilac, Ronisol, Ronite	UF, PF, CA, For injection molding	Soc. La Ronite, Rosny, Seine, France
Rucel	D, Rubber-cellulose mixture	See Flax.
Runerit	PF, l, m	Electro-Isolier-Industrie, Wahn, Ger.
Safetee Glass	SG, Px	Safetee Glass Co., Wissinoming, Pa.
St. Bernard	F, Molded articles	A. W. Kanis, London.
Sakaloid	X, From sugar	Industrial Sugar Prod. Corp., N. Y.
Samson-Celluloid	Px, Film	Celluloid Corp., Newark, N. J.
Sanophon	F	Ozonol Laboratories, London.
Satolite	C	Sankyo Kabushiki Kaisha, Tokyo, Jap.
Schellan	UF, s	Kunstharzfabrik Dr. Fritz Pollak, Vienna.
Schellit	PF, t	Kunstharzfabrik Dr. Fritz Pollak, Vienna.
Securex	SG	Germany.
Sécurite	CA	Cie. Petit-Collin-Oyonnithe, Paris.
Seracelle	V, Sheeting	Courtaulds, Ltd., London.
Sicalite	C, f	Soc. Nobel Francaise, London.
Sicoid	CA	Soc. Industrielle Celluloide, Paris.
Sigaleos	PF	Italy, (**Plastics, 6,** 589, 1930).
Similoid, Similex, Sinur	CA	Europe (Blücher 153).
Solidite	F	Solidite & Synthetic Mouldings, Ltd., London.
Solith	PF, t	Rejal und Spol, Prag, Czechoslov.
Souvelo	F, UF, ? Ware	Souvenir Mfg. Co., Birmingham, Eng.
Spauldite	PF, l, Gear material	Spaulding Fibre Co., N. Rochester, N.H.
Splintex	SG, CA, Safety glass	Splinterless Glass Co., Ltd., Teddington, England.
Sportsman	F	A. W. Kanis, London.
Stabilite	?	Soc. Grandgener, Perreux, France.
Starkware	UF, ?, Ware	U. S. A.
Sterilin	CA, Surgical tissue	Germany.
Streetly	UF, F, Ware of Beetle, etc.	Streetley Mfg. Co., Ltd., London.
Superisolite	PF	Italy (**Plastics, 6,** 587, 1930).
Super-Micanite	X, Mica bonded with glyptal	(**Brit. Plast., 2,** 444, 1931).
Syn-phorm	D	Blackburn & Oliver, England.
Synthaform	F	Synthaform, Berlin.
Syntholite	PF, ?	Soc. Anon. la Syntholite, Paris.
Syrolith	C	Sweden (**Gummi-Ztg., 45,** 935, 1931).
Tapa	?, Molded articles	W. J. Charlesworth, Ltd., Birmingham, England.
Taumalit	PF, t, f	Isopreeswerk, Berlin.
Teglac	D, Lacquer resin	American Cyamid Co., New York.
Telenduron	?, m	Thomas De la Rue & Co., London.
Tenalan	P, f	(**Plastics, 6,** 705, 1930).
Tenazit	PF, (see Textolite)	Allgemeine Electricitaets-Gesellschaft Berlin.
Tenegrine		Soc. Rhodiaseta, Paris.
Tensulam	?, m	Benj. Wiggins & Co., Ltd., England.
Tetrolith	?	Kunsthornwerke Teterow, Mecklenburg, Germany.
Textolite	P, f, m, l	General Elec. Co., Schenectady, N. Y.
Text-Tiles	UF, ?, Tiles	Kelacoma, Ltd., Welwyn, Garden City England.
Thermasote	W, Fiber board	Agasote Millboard Co., Trenton, N. J.
Thermoplax	X, Cold molding	Cutler-Hammer, Inc., Milwaukee, Wis.
Thesit Supra	?, Resin molding powder	Presswerk A. G., Essen, Germany.
Thiobonite	X, Hard rubber and resins	(**Plastics, 7,** 19, 1931).
Thiojectite	?, For hot die-casting	(**Plastics, 7,** 19, 1931).
Thiolite	PF	Soc. Levy, Samuel, et Levy Joinville, France.
Thorax	SG, Safety glass	Muhlig Union, Prag Czechoslovakia.
Tortaloid	CA, F	Fiberloid Corp., Indian Orchard, Mass.
Transparit	V, P	Wolff & Co., Walsrode, Germany.
Trefoil	PF	Bakelite Ltd., London.
Triolin	Px, Floor covering	(**Brit. Plast. 2,** 225, 1930).
Triplex	Px, SG	Triplex Safety Glass Co. of N. A., Clifton, N. J.
Trolit	Px, CA	Shapes molding powders, injection materials, lamination — Rheinisch-Westfaelische Sprengstoff A. G., Troisdorf, Germany.
Trolit-Spezial	PF, m	
Trolitan	PF, m	
Trolitan H	UF, m	
Trolitax	PF, l	
Trolitul	X	
Trolon	PF, ?, t	
Tufnol	PF, l, f	Ellison Insulations, Ltd., Birmingham,
Turax	PF	(**Plastics, 6,** 705, 1930).
Turbax, Turbonit	PF, l, PF, m	Jaroslaw's Glimmer - Waren - Fabrik, Berlin.
Ultrasit	PF, t	Chemische Fabrik Ambrasit, Vienna.
Ultrastrip	F, Sheeting	Troughton & Young, Ltd., London.
Unex	SG	Unex Single Sheet Safety Glass Co., London.
Unyte	UF, m	Unyte Corp., New York.
Uralite	UF, m	Soc. Resins et Vernis Artificiels, Paris.
Utilit	PF, t	Augsburger Kunstharz-Fabrik, Augsburg, Germany.
Velskin	?, Sheeting	Albion Shades, Ltd., England.
Veryx	UF	Edgard Israel, France.
Vetroloid	?, Sheeting	Albion Shades, Ltd., England.
Victron	X, Styrol molding powder	Naugatuck Chemical Co., New York.
Vigorit	PF, t	Dr. F. Raschig, G.m.b.H., Ludwigshafen, Germany.
Vinylite	X, D, Vinyl resin base	Carbide & Carbon Chem. Corp., N. Y.
Viscacelle	V, ?, Sheeting	Courtauids, Ltd., London.
Viscoloid	Px, f	du Pont Viscoloid Co., Leominster, Mass.
Visking	V, Sheeting	Viskng Corp., Chicago.
Vitalite	CA, ?, "Flexible glass"	New York Wire Cloth Co., New York.
Vitreo-Colloid	CA, P, Closures	J. M. Newton Vitreo-Colloid, Ltd. London.
Vitroluz	?, Optical cellulose comp'd	W & G Baird, Ltd., England.
Vortex-Burt	PF, F	Vortex Cup Co., Chicago.
Wahnerit	PF, l, Unpregnated paper	Elektro-Isolier-Industrie m.b.H., Wahn, Germany.
Walonerit	?, m	Elektro-Isolierindustrie, Germany.
Wandrite	PF	H. Wandrowsky, Berlin.
Waterlite	X, Styrol	Watertown, N. Y.
Wenjazit	PF, t	Kunst-Rohstoff A. G., Hamburg, Ger.
Xetal	SG, CA	England.
Xilite	PF, t	Italy (**Plastics, 6,** 589, 1930).
Xylolith	B, Flooring (Magnesia)	Deutsche Xylolith Platten Fabrik, Ger
Xylonite	Px, f	British Xylonite Co. Ltd., London.
YZ	F	Henry Howell & Co., London.
Zalmite	W, Shells, Burlap, etc.	Simmons Co., Kenosha, Wis.
Zellith	CA (See Cellit)	
Zellon	CA (See Cellon)	
Zellosit	(See Cellosite)	
Zellugol	CA	Germany (**Kunststst., 21,** 87, 1931).
Zeolite	C, f	Soc. Polenghi Lombardo, Codogno, Italy.
Zyl	Px, F, Generic name sponsored by **Plastics** for pyroxylin plastics	(**Plastics, 3,** 205, 1927.)
	B, Magnesite for molding	M. E. Converse & Son Co., Winchendon, Mass.
	C, m	Sarvis Osakeyhtio, Tammerfors, Finland.
	CA	Fabbrica Bonelli, Cesano Maderno, Italy.
	CA, m	Acetate Products Corp. Ltd., London.
	Px, CA, Film	du Pont Pathé Film Mfg. Co., Parlin, N. J.
	Px, CA, Film	Eastman Kodak Co., Rochester, N. Y.
	P, Wrapping material	Natural Products Conversion Corp.
	PF	Magnasco Roggero & Co., Genova.
	Px, Plastics	Westfaelisch-Anhaltische Sprengstoff A. G., Berlin.
	SG, Px	Ford Motor Co., Detroit, Mich.
	SG	Johnston Glass Co., Hartford City, Ind.
	SG, Px	Libby-Owens-Ford Glass Co., Toledo, Ohio.
	UF, t, m	Meunier (France).
	X, Aldehyde resins	Consortium für Elektrochem. Ind. München.

Removing Acidic Gases by Reaction With Organic Bases

By R. R. BOTTOMS
Director of Research
The Girdler Corp.
Louisville, Ky.

ONE APPLICATION of the problem of eliminating acidic gases from industrial gas is that of the removal of carbon dioxide from natural gas prior to the liquefaction of the natural gas for the extraction of helium; another is in the manufacture of liquid CO_2 as described on p. 139, *Chem. & Met.*, March 1931. Helium-bearing natural gas contains carbon dioxide varying from a trace to a much as 80 per cent in certain rare instances. The gas processed in the Helium Co.'s (subsidiary of The Girdler Corp.) plant at Dexter, Kan., analyzes 0.3 per cent carbon dioxide, while that used in its Model Dome operations at Thatcher, Colo., contains 15 per cent. This gas is very peculiar in that it contains the largest percentage of helium ever discovered in natural gas, namely, 8 per cent, the balance being nitrogen and carbon dioxide. It does not contain any hydrocarbons.

It is well known that every trace of carbon dioxide must be removed from gases previous to their liquefaction in order to prevent the rapid clogging of the small tubes in heat interchangers through the accumulation of solid carbon dioxide. For the removal of this carbon dioxide there were several standard methods available, all involving alkaline scrubbers which leave either sodium carbonate or calcium carbonate to be disposed of.

A method was therefore sought for removing carbon dioxide from natural gas which would consist of a closed-cycle operation absorbing the carbon dioxide in one part of the apparatus and disengaging it in another part without forming any waste product. The first of the continuous closed-cycle processes studied used potassium carbonate for scrubbing followed by boiling of the bicarbonate solution formed, in order to disengage the carbon dioxide. Laboratory tests indicated that with this method it would be practical to reduce the carbon dioxide content to about 0.1-0.2 per cent. It was found, however, that so much solution was required that the heat needed for its reactivation would be uneconomic. It was therefore concluded that in order to utilize a continuous closed cycle it would be necessary to find some more suitable absorbent.

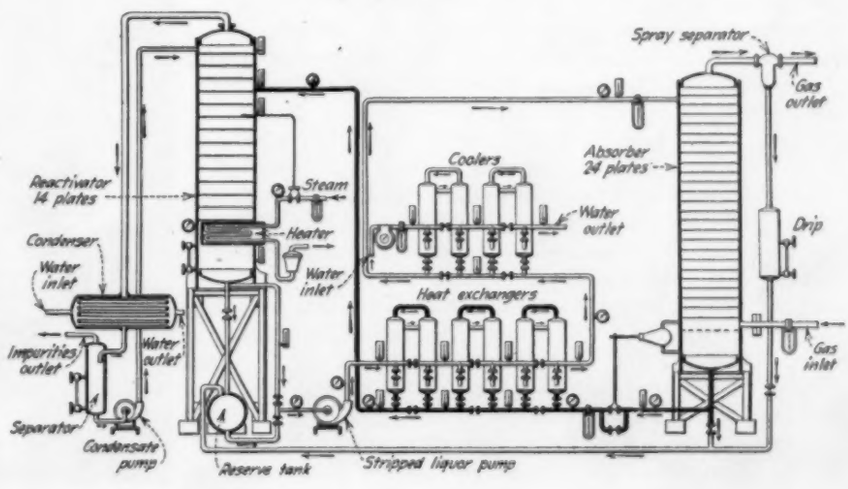
A reagent satisfactory for the continuous separation of carbon dioxide should have the following characteristics; (*a*) Absorb CO_2 readily and in large volume; (*b*) release CO_2 readily at relatively low temperatures; (*c*) be stable in the presence of the constituents of the gaseous mixture and materials of construction at the boiling temperature of the solution; (*d*) have vapor pressure, either in solution or free, low enough to avoid loss of the material due to evaporation.

Among the compounds tested, it was found that aniline and a number of other nitrogen bases, while sufficiently basic to form crystallizable salts with the strong mineral acids, were not sufficiently basic to form carbonates. Carbonates of some other nitrogen bases, notably guanidine and piperidine, were not dissociated upon heating and consequently were not adaptable to this process. Ethylamine and other amines of lower molecular weight, while possessing high specific absorption and sufficient instability of the carbonate at higher temperatures, were too volatile, promising excessive losses by evaporation.

A great many nitrogen bases were studied to determine which possessed the properties necessary to make them of value for this purpose. Among the compounds studied and found to offer possibilities were:

Reagent	Calculated Absorption Capacity (Volumes gas per volume reagent)
Amino ethanol	229
Benzylamine	170
Diaminopropanol	270
Diethanolamine	128
Diethanolamino-ethanol	115
Dihydroxylpropylamine	135
Hydrazine hydrate	115
Pentanolamine	130
Piperidylethanol	140
Phenylhydrazine	107
Triethanolamine	90
Triaminopropane	300
Cyclohexanolamine	130

Gas Purification Layout at Thatcher (Colo.) Plant of the Helium Co., Using Triethonolamine



Some of these compounds are not soluble in water; others are entirely satisfactory with the exception that the vapor pressure is relatively high, notably pentanolamine. However, it was found during the investigation that the ethanolamines listed above—that is, diethanolamine and triethanolamine—possess the characteristics required.

The ethanolamines were prepared by Wurtz in Germany about 1860, but the compounds have been available commercially only in very recent years, whereupon a more thorough investigation could be made of their properties and of their desirability for use in separation of carbon dioxide and other acidic gases from gaseous mixtures. The ethanolamines apparently are more basic than ammonia and will displace ammonia from ammonium salts. But since they are relatively weak bases, compared with alkali hydroxides, their carbonates have a definite dissociation pressure. This varies not only with the percentage of the base converted to the carbonate but also with the temperature.

In operations using diethanolamine for the absorption of carbon dioxide, a 50 per cent water solution has been found to be entirely satisfactory. The molecular weight of diethanolamine is 105 and it is a mono-acid base. Theoretically, then, 105 gr. of diethanolamine should absorb 22 gr., or 11 liters, of carbon dioxide. This would amount to about 110 c.c. of carbon dioxide to each cubic centimeter of diethanolamine, but since some dicarbonate as well as neutral carbonate is formed, a 50 per cent solution will absorb about 72 volumes per volume of solution when the partial pressure of the carbon dioxide over the solution is equal to one atmosphere and the temperature is about 35 deg. C.

The heat liberated due to the absorption and reaction of carbon dioxide in diethanolamine has been determined experimentally to be 650 B.t.u. per pound of carbon dioxide absorbed. This heat of reaction for hydrogen sulphide, on the other hand, is 511 B.t.u. per pound of hydrogen sulphide absorbed. In heating solutions of diethanolamine to drive off carbon dioxide or hydrogen sulphide after absorption, a certain quantity of water also is vaporized. This quantity of water corresponds to the quantity of water saturating the carbon dioxide at the temperature at which it leaves the solution. Heat sufficient to vaporize this quantity of water then must be introduced into the reactivating kettle in addition to the quantity corresponding with the amount of heat generated upon the absorption of the gas by the solution. By calculating the quantity of water driven off during this reactivation period from a given quantity of solution, and the heat necessary to dissociate the carbonate as well as raise the temperature of the solution from the inlet temperature to the boiling plant, the total heat required in the process for reactivating the solution can be accurately determined.

It has been found experimentally that when a solution of diethanolamine saturated with CO_2 is heated to 95 deg. C., about 90 per cent of the total carbon dioxide absorbed in the solution may be eliminated. In liberating the other 10 per cent of carbon dioxide it is necessary to boil off a small quantity of water. When a solution of diethanolamine saturated with carbon dioxide is heated, an active liberation of carbon dioxide begins immediately. By the time the boiling point of the solution is reached it is found that almost all of the carbon dioxide has been liberated.

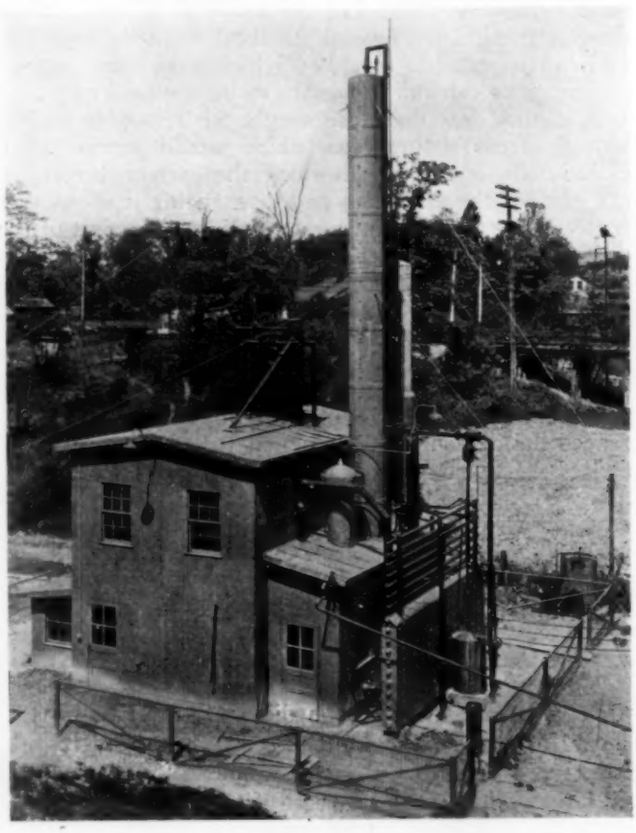
Practical operation of the absorption process is shown in the diagram of the helium production plant of the Helium Co. at Thatcher, Colo. This installation reduces the carbon dioxide content of the gas on the average to about 0.01 per cent. The original composition of the gas at Thatcher is carbon dioxide, 15; helium, 8; hydrocarbons, 0; and nitrogen, 77 per cent.

The system operates as follows: Gas is delivered to the plant at about 350 lb. pressure, enters the absorber and passes up countercurrent to the descending amine solution, where the carbon dioxide is almost completely stripped from the gas. The solution of amine carbonate passes out of the base of the absorber, through the heat interchangers countercurrent to the reactivated solution of amine from the reactivator, and in this heat interchanger the temperature of the solution is raised to about 80 deg. C. The solution then passes into a mid section of the reactivator tower, down over the bubble plates, and finally reaches the kettle of the reactivator, which contains steam coils, where the solution is held at its boiling point. The steam from the kettle passes through the bubble plates countercurrent to the descending solution, removing the carbon dioxide.

Some of the steam progressively condenses as it meets the descending colder solution, heating the solution to its boiling point and disengaging the carbon dioxide as it approaches the base of the tower. The disengaged carbon dioxide passes to the condenser at the top of the reactivator, where the water vapor saturating the carbon dioxide is condensed and the condensed water passed back to the top of the tower. The carbon dioxide passes out of the condenser and in this particular instance is permitted to go to waste.

The reactivated solution is then pumped out of the kettle and passed through the heat interchanger countercurrent to the cold saturated solution from the absorber and then to the precooler, where the solution is cooled to a temperature of about 40 deg. C., and then back into

Gas Purification Plant of the Helium Co. at Thatcher, Colo.



the top of the absorber. This operating temperature has been found to be entirely satisfactory for carbon dioxide removal. The reaction seems to be more rapid at this than at a lower temperature; consequently more complete removal of carbon dioxide is obtained. If a temperature higher than 40 deg. C. is used the partial pressure of the carbon dioxide over the amine carbonate solution is increased and consequently the removal of carbon dioxide from the gas per unit volume of solution is adversely affected; therefore the circulation of a larger quantity of solution is required to obtain equivalent separation.

The question of the stability of the ethanolamines when used as an absorbent for carbon dioxide has been settled through the experience of the Helium Co. in the operation of its carbon dioxide removal system at Thatcher, Colo. It has been mentioned before that the carbon dioxide content of the gas at Thatcher is reduced to less than 0.01 per cent. This residual trace is then removed by further scrubbing with caustic soda solution. In the use of a caustic soda solution in the cycle care must be exercised that the triethanolamine solution does not become contaminated by the caustic. Caustic soda has such a damaging effect on the triethanolamine solution that a contaminated mixture cannot be used. But approximately 75,000,000 cu.ft. of gas has been passed through the Thatcher system without any decrease in quantity of solution or in its absorption efficiency.

The success achieved with this process at this plant has demonstrated that it can be used to advantage in the separation of carbon dioxide from other industrial gases. The process also is successfully used for the separation of hydrogen sulphide from natural gas, refinery gas, and other industrial gases.

▼ ▼ ▼

Producing Phosphorus Smoke Screens

By B. G. MACINTIRE
Edgewood Arsenal, Md.

DESPITE the number of materials used during the World War to produce smoke screens and the many others that have been tested since then, the most efficient discovered so far, from the standpoint of its screening power, is phosphorus. Burned in an excess of air, it produces P_2O_5, which quickly combines with moisture in the atmosphere, under conditions of high relative humidity, to produce solutions of phosphoric acid. Since the absorption of water results in an increase in the size of the smoke particles, damp air is favorable.

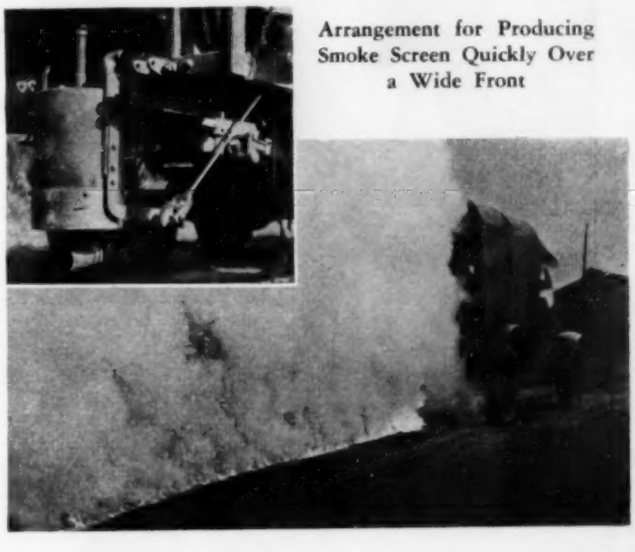
Since smoke clouds are always in motion, it is necessary to set up a smoke screen at a point upwind, so that it travels between the observers and the object it is desired to screen. The motion of the cloud may be upward, due to convection air currents, and it spreads laterally at right angles to the direction of wind travel. An excessive rise of the cloud is often undesirable, however, when the line of vision to be screened is near the ground.

The factors which influence the travel of the smoke cloud are: first, those resulting from the method of dispersion; and, second, those due to meteorological conditions which affect its general travel. We have, of course, no means of controlling the latter, but it is possible to increase the effectiveness of a smoke screen by using a suitable method of dispersing the smoke material so as to reduce the initial rise to a minimum. If a careful control be maintained over the rate of generation and the units be properly distributed, the artificial convection air currents usually set up may be reduced to a minimum.

One of the simplest type of candles is that in which white phosphorus burns without control on the ground. This type usually is ignited electrically by firing a chemical heating mixture to produce sufficient heat to open a soldered seam and allow molten white phosphorus to flow onto the ground, where it burns without control. But the screen produced is brief, irregular, and only partly effective, because of the heat currents.

A more efficient type designed at Edgewood Arsenal produces smoke at a uniform rate for a definite period of time. The body of the candle, which is circular, is pressed from a single piece of metal, and the construction of the candle is completed by soldering on a top. The candle is filled under water with molten phosphorus through an opening, after which it is sealed. It operates when the soldered joint is melted by means of a chemical starting heat mixture, which may be fired electrically. This releases the soldered metal disk, so that it drops to the bottom of the container. The phosphorus burns at a uniform rate from the start, since the burning surface remains the same throughout the life of the candle.

A method for producing a smoke screen quickly and efficiently over a wide front is shown in the illustration. It consists in distributing liquid phosphorus on the ground at a uniform rate from a container attached to some type of motor vehicle in rapid motion. The closed container, in which the white phosphorus is placed, is provided with an outer jacket around the sides and bottom, an air vent on top, and a discharge pipe in the bottom. After placing the white phosphorus in the container, it is brought to the molten condition by passing the exhaust from the motor vehicle into the jacket. When molten, it is released from the tank and allowed to flow onto the ground while the motor vehicle is in motion. As the molten phosphorus comes in contact with air, it fires instantaneously.



Arrangement for Producing Smoke Screen Quickly Over a Wide Front

LOWERING COSTS

In Lifting Process Materials

By L. B. MURDOCK
Chicago, Ill.

HANDLING the three classes of chemical ingredients: namely solids, liquids, and gases, involves problems that are many and varied, each calling for a distinctly different type of equipment. Gas handling is, perforce, accomplished with a good degree of efficiency in most plants, but the necessity for proper handling facilities has not always been so urgent from a manufacturing standpoint in the case of solids (and liquids in containers), for they can, although with excessive labor and accident likelihood, be moved manually. Competition, however, has done much to force the mechanization of these operations, and manufacturers are coming to realize the savings which can be effected.

It is not so difficult to transport material in and about a plant without adequate means as it is to raise and lower it, operations which entail more effort per pound moved and are more dangerous if improperly done. In the ceramic industry, for example, raw materials can readily be brought to the door of the kiln on hand trucks. To raise the load to the level of the kiln floor is a much more difficult task and not so readily accomplished unless the proper facilities are provided. Fig. 1 illustrates this point, showing how a simple, portable electric lifter can be used to expedite the loading and unloading operations. The operator gives the control cables a short pull and rides up with the load, whereupon adjustable buttons cause the platform to stop automatically at the proper level. When one kiln is completed, the lifter, being readily portable, is simply hauled to the next one, much as a hand-lift truck would be. In the installation shown, the user has found that the lifter has decreased his kiln-loading costs by $5 per day.

Fig. 1—This Portable 1,000-Lb. Electric Lifter Reduced Kiln Charging Costs by $5 Per Day

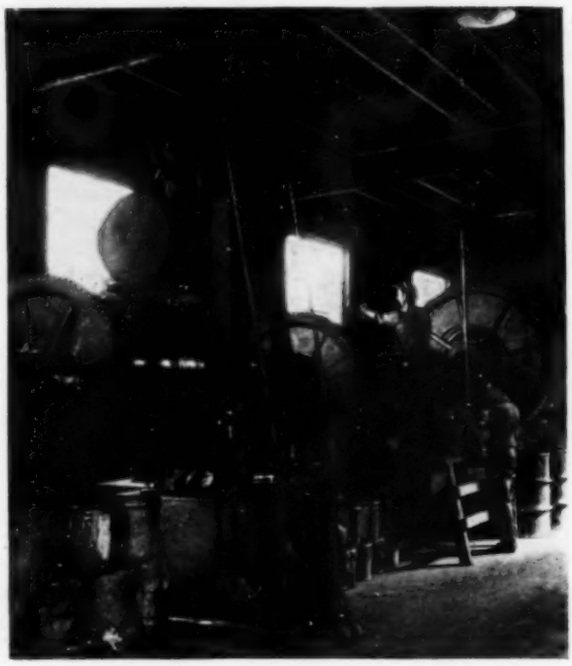


Fig. 2—Buckets Have Given Way to an Electric Lift in Charging Mixers in This Paint Plant

Without a device of this nature it would be necessary either to resort to excessive handling or to the building of a long ramp. This latter method, while satisfactory for some uses, should not be considered as a means of moving heavy materials from one floor level to another. Generally speaking, ramps increase the hazard to both load and workmen. While one man can move the average loaded hand truck along the floor, *men* are needed to move it up an incline. The pitch of such a ramp, if slight enough to permit free movement, requires the use of too much floor space.

Problems of lifting in the process industries, while often similar in character, ordinarily call for individual treatment to meet the conditions surrounding the movement of the materials. Serving mixers, for example, might seem to be a problem that would lend itself to standardization of both type and size of elevating unit. However, practically every job differs in some detail, making specially adapted equipment desirable or necessary. A solution of this problem, as applied in a paint plant, appears in Fig. 2. The hoist in the foreground permits one man to elevate and drain directly into the mixer one 50-gal. drum at a time. The drum is placed

on the elevating platform with the open bung at the top, and is raised to the proper level. The machine is moved forward on its wheels until the outer edge of the platform is above the opening in the mixer. The operator then rolls the drum forward and drains the contents. The method formerly employed for this operation is pictured in the background to illustrate the contrast. Before the newer method was put into service, filling a mixer was about three times as costly.

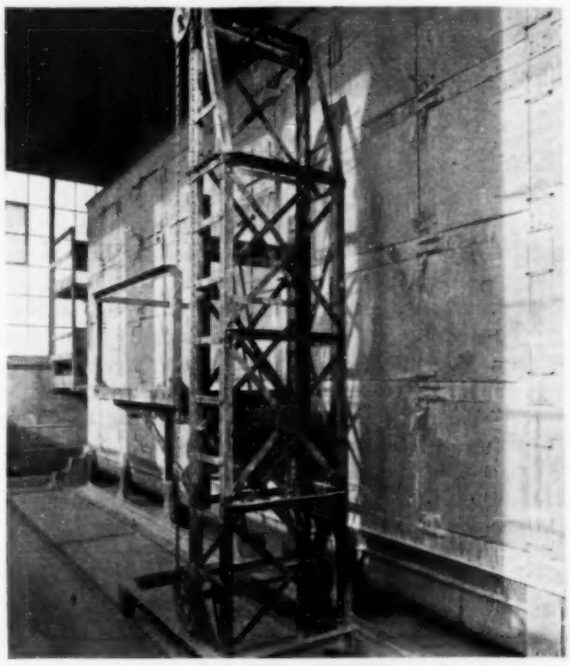


Fig. 3—Loading and Unloading This Tray Dryer Is Handled by One Man and an Ingenious Lifter

A variation of this device is often used in filling open-top mixers and vats. Instead of a platform the lifter has a pair of arms between which a container of liquid, paste, or solid material is supported. When the elevation is not too great the container can be dumped by the workman from the floor. Otherwise a simple winch-type dumping arrangement may be used, permitting the safe handling of large quantities at a time.

Another case where an ingenious machine of special design was used very satisfactorily is shown in Fig. 3. The operation is the very common one of removing pans of solids from a drying oven. In this case the doors of the ovens range in elevation from approximately 2½ ft. to 12 ft. above the floor. Each must be opened and the pans and their contents withdrawn with care One man riding on the platform of the lift accomplishes the job with ease and dispatch. A crank on the platform frame connected to the hoisting mechanism permits him to adjust the elevation as desired. The chain shown enables him to move the lift along the track without leaving the platform.

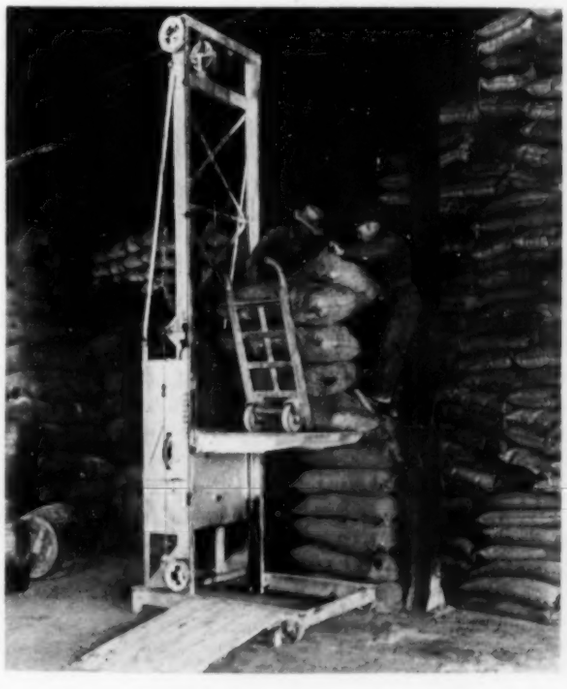
After a product has been finished it is no less important that it be efficiently handled. In the warehouse, awaiting distribution to the consumer, the product should be stored so as to waste as little space as possible. Thought should be given to the prevention of unnecessary handling and to the ready accessibility of all grades. Proper rotation of stock is another essential which must have consideration. How these results are attained will depend, of course, on the type of material and the type and weight of the package. A method often used in storing drums is to provide racks onto which the drums are rolled from a lift platform. In some cases additional space may be obtained through the use of a balcony, and here a telescoping lifter is of much service, since it may be used both beneath the balcony and in lifting packages from the floor to the balcony.

Dry materials in sacks and bags, while not excessively heavy as units, are ungainly and cumbersome to handle. In warehousing them, a number can be placed on the common two-wheel hand truck and moved into the storeroom. If it is not crowded for space, the truckloads can be deposited side by side, leaving the bags piled five or six high. Where floor space is at a premium the overhead area must be utilized by stacking, either by hand or with some mechanical assistance. Doing the job by hand had three principle disadvantages: namely, the number of men necessary, the time consumed, and the fact that the bags must be "stepped" away from the aisle, thereby losing much of the space.

A number of the more aggressive fertilizer manufacturers have installed the method shown in Fig. 4 in their storage buildings. In this manner five or six 100-lb. bags can be raised by one man, quickly and on the same truck which delivers them to the hoist. The bags are then dropped, rather than lifted, into position on the pile. All manual lifting is eliminated and the material piled straight up from the floor to the ceiling on either side of the aisle. When the storage space is crowded, the width of the aisles can be reduced to about 4 ft. and still permit free movement of the materials in and out.

Mechanical handling, as it has been described here, must necessarily differ considerably in its details from job to job. Its benefits, however, are substantially similar in most cases; namely, lower operating costs, faster production, less spoilage, better workmanship, and fewer accidents. Needless to say, the last point is not by any means the least important for industry's annual accident loss is very large, and investment in greater safety is well worth while.

Fig. 4—Fertilizer Storage Is Facilitated With Safety and Space Economy, Using an Electric Lifter



READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Conditions for Pyrite Burning In Acid Plant

To the Editor of Chem. & Met.:

Sir:—The article by F. W. Adams, entitled "Combustion of Pyrite in a Herreshoff Furnace," in your June issue, has been read with considerable interest, but certain statements in the first paragraph may be misleading to one not conversant with the operation of a contact sulphuric-acid plant treating roaster gas.

We are operating several Herreshoff furnaces roasting pyrite and pyrrhotite concentrates for the combined purpose of producing sulphuric acid and iron sinter. Both contact and chamber processes are in use: the chamber process produces acid largely for the fertilizer industry; the contact process produces acid of high purity as well as greater concentration for textile and other industries. The sinter, low in sulphur and phosphorus and high in iron, has a ready market in competition with the highest grades of foreign iron ores.

Mr. Adams states, "The gas concentration must be between 8 and 12 per cent sulphur dioxide; sulphur recovery should exceed 95 per cent." It happens that the gas entering our contact plant contains a minimum of 5½ per cent, and a maximum of 7 per cent of sulphur dioxide, no fuel oil being required to maintain converter temperatures. We also find that it is economical to leave considerable sulphur in the calcine for fuel in sintering rather than recover 95 per cent of the sulphur from roasting.

Mr. Adams further states, "the cinder under present conditions is not only of no value, but, requiring dumping expense, cannot share the cost of burning." We find that cinder or calcine properly sintered is a valuable and marketable product.

J. H. TAYLOR.

Research Engineer
Ducktown Chemical & Iron Co.
Isabella, Tenn.

To the Editor of Chem. & Met.:

Sir:—Mr. Taylor's utilization of the iron sinter to replace iron ore affords a very satisfactory disposal of byproduct. His low gas concentration is consistent with byproduct recovery, where often the value of the calcine is of almost equal importance with the value of the burner gas. With suitable heat exchangers designed to handle this low gas concentration it should not be necessary to supply heat with an auxiliary fuel. I do not believe that any further comment is necessary, as Mr. Taylor's letter is in the nature of supplementary information.

F. W. ADAMS

School of Chemical Engineering Practice
Massachusetts Institute of Technology,
Cambridge, Mass.

Successful Fueling With Wyoming Lignite

To the Editor of Chem. & Met.:

Sir:—I have read the article, "Lignite and Ceramics Dominate Research at North Dakota," by Irvine Lavine, in the November, 1930, issue, and would like to point out the uses to which lignite is put in Wyoming.

Some years ago, the Burlington Railroad succeeded in so converting its locomotives as to burn lignite as a fuel as mined, with no further treatment. Of course, this was a somewhat difficult task for men experienced in firing Eastern coal, but for this reason the Burlington will not employ experienced firemen on the Wyoming division. The inhabitants of this section have used lignite for years as a fuel in their homes, under the few boilers that are to be found in this section of the country, and the railroads use it under the boilers of their power plants at shops and pumping stations.

The writer has been informed that tests were made to successfully employ this coal, mined at Monarch and Deitz, Wyo., near Sheridan, in a new process for making commercial gas. Experiments were started as early as 1912 at Deitz and successfully terminated in 1921 or 1922. It is understood that this process utilizes the fines from the mines in this vicinity—a product that was for years considered waste only.

Experiments made on the Burlington have shown that these fines can be used successfully in locomotives through the use of stokers.

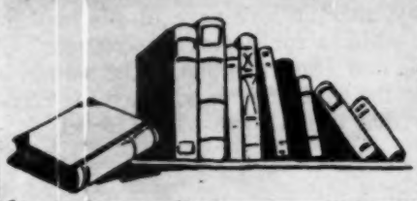
The writer has experimented with these mine fines, as hauled to the dump, and succeeded in firing them in a pulverized condition without preliminary drying. This process will leave no trace of ash or clinker on the brickwork. It was found necessary to close up the grates entirely with brick and supply the air to maintain combustion at the same time and with the pulverized lignite. The successful results were attributed to a new method of igniting the pulverized lignite that was worked out and applied. The earlier test of using a pre-ignited bed of lignite or an oil spray as methods of igniting the powdered lignite was not a success, as they were the cause of the clinkers which were found formed in hard porous masses on the grates, in some cases completely filling the firebox after only a few hours' test, and which had to be broken up with chisel bars to remove them.

In the later method, it was necessary to use quite an elaborate type of brick arch and firebox to cause a circulation of the air and the powdered lignite; otherwise, much of the lignite was drawn into the tubes by the draft and partly burned there, or in a partly burned condition fell on the brickwork to form clinkers.

C. G. WILLIAMS.

1700 Cedar St.,
Green Bay, Wis.

Chemical Engineer's Bookshelf



Soap and Detergents

CHEMIE UND TECHNOLOGIE DER SEIFEN UND WASCHMITTEL. Ubbelohde's Handbuch der Ole Und Fette, Second Edition, Vol. III, Part 2. Edited by *Hans Heller*. S. Hirzel, Leipzig, 1930. 752 pages. Price, unbound, 68M; half leather, 75M.

Reviewed by O. H. WURSTER

THE complete revision during the past few years of this systematic and comprehensive work covering the chemistry and technology of fats and oils has resulted in a very desirable and valuable addition to our technical literature. The publication of the first edition by Ubbelohde and Goldschmidt required from 1908 to 1926 for completion. From the standpoint of time, the accumulation of knowledge, and the advances in technology, the several volumes of the work had become unbalanced. The revision during the past several years of Vols. I to III has corrected this. Vol. IV, 1926, of the first edition, edited by Dr. M. Hartmann, being comparatively new, is retained as part of the second edition.

In accordance with its title, Vol. III, Part 2, deals with the chemistry and technology of soaps and washing materials. In general, the treatment established by Goldschmidt in the first edition has been followed. The sections devoted to physical and colloid chemistry have been greatly augmented to meet the advances in these subjects. The technical sections have been balanced by additions and deletions that appear, by comparison of the two editions, to be well justified.

The entire technical presentation is limited to German practice. To us, therefore, the value of this volume lies in its orderly and comprehensive treatment of the chemistry of the subject and of the details of the technology as carried out in Germany. It immediately becomes obvious that soap manufacture in Germany and in the United States is carried out quite differently. The chemistry, of course, and basically, also, the technology are the same, but when it comes to methods and equipment, the two countries appear to be about as different as the products which are in popular demand and the scale on which they are produced. This difference in established practice, which is clearly indicated by this authoritative treatise, is of interest in connection with the recent attempt to introduce into American plants methods of soap making reported to be in successful use in Germany.

The difference appears to hinge largely on the differences involved in the scale of the operations, with the consequent influence on the methods of operation and the equipment used. Equipment for small plants and simple hand-operated machines are described. It is noted that considerable space is devoted to soap cooling machines, a type of equipment which has not been adopted by the American soap manufacturer. By inference, from its omission, it appears that our highly developed equipment for large-scale and more or less automatic production has not found acceptance in Germany. From the standpoint of American practice, we would criticise this omission in such a comprehensive work.

It would appear that the manufacture of soap powder, powdered soap, soap chips, and soap flakes is relatively less extensive in Germany than in America. On the other hand, considerable space is devoted to special soaps—as, for example, "Eschweger Seifen"—which are of negligible importance here.

These observations, relative to omissions as they appear from an American viewpoint, are really inspired by the very completeness, the thoroughness of chemical and technical treatment, and the monumental nature of the entire work. The editor and his collaborators having accomplished so much, one gets the feeling that it should be more comprehensive or international in its presentation of modern soap products and manufacturing practice.

Coal as Source of Gases

WASSERSTOFF. By *W. Gluud, K. Keller, et al.* Berichte der Gesellschaft für Kohlentechnik, Vol. 3, Part 3. Published by the Society at Dortmund-Eving, Germany, 1931. 370 pages.

Reviewed by WILLIAM B. PLUMMER

THIS volume does not, as its title might indicate, deal with the general aspects of the production of hydrogen from coal but with a specific process developed by the authors for the production of hydrogen from coke-oven gas. It is, of course, possible to recover large quantities of hydrogen from coke-oven gas by liquefaction of other constituents (Linde-Brown-Caro process), but the hydrocarbons therein are wasted as far as hydrogen production is concerned. The authors have developed a process in which coke-oven gas is completely utilized for hydrogen production, which consists in treating the entire gas at elevated temperatures with steam to form hydrogen and carbon monoxide, then converting the carbon monoxide to carbon dioxide and removing the latter subsequently by passing the mixture over heated dolomite.

The major part of the volume is taken up with theoretical discussion and data and with the description of experimental studies and results, various modifications of the process having been investigated. The remainder of the volume describes the construction and operation of a large-scale experimental plant installed

at the Zeche Victoria, Lünen. Cost calculations indicate that the process can compete with other processes under favorable conditions. The application of the process to production of hydrogen from natural gas also is discussed. While obviously very limited in scope, the volume represents a valuable contribution to the literature on hydrogen production.

KOHLENWASSERGAS. Vol. 19, "Kohle-Koks-Teer". By *J. Gwosdz.* Verlag Wilhelm Knapp, Halle, Germany, 1930. 203 pages. Price, 19.50 M.

LIKE many other German technological monographs, this volume on the production of water-gas from bituminous and other coals is a valuable compilation if used with sufficient discretion and knowledge. More specifically, the present reviewer hopes some day to read such a monograph where in each section the commercially operable and successful processes are clearly distinguished from unsuccessful processes and from those which have been proposed but never operated. Although suffering from this common fault, the present volume otherwise represents an excellent compilation of information on this particular field. Recent American developments are at least touched upon. Experimental results and proposed processes for the complete gasification of pulverized fuels and for the continuous gasification of coal by highly superheated steam or by steam-oxygen mixtures are summarized in considerable detail. The volume is well arranged and fairly well illustrated and indexed. For the reasons previously stated, however, it would be likely to give a somewhat distorted picture to persons not in touch with the field.

Properties of Pure Iron

EISEN UND SEINE VERBINDUNGEN. Abeggs Handbuch der Anorganischen Chemie. Vol. IV, Section 3, Part 2, A. Edited by *I. Koppel.* S. Hirzel, Leipzig, 1931. 336 pages. Price, 40M.

Reviewed by JOHN JOHNSTON

THIS division of the eminent handbook treats of the element iron and its compounds. The present portion, under the editorship of Prof. I. Koppel, deals with the following main topics: atomic weight, 16 pages; the iron-atom (spectra), 34 pages; preparation of pure iron, 44 pages; and properties of (pure) iron, the remainder. This last is subdivided under the headings: states of aggregation and their stability limits; space lattice and crystal form; volume, density, expansion, compressibility; mechanical properties; thermal properties; optical properties; magnetic properties; electrical properties; and electromotive and electrochemical behavior.

The writers of these chapters had a difficult task by reason of the almost entire lack of measurements on material which may be regarded as really pure iron. They had therefore to discuss the measurements available on the purer samples of iron, to endeavor by comparisons to evaluate the influence of each of the several other elements present, and by this means to extrapolate from a group of data to the properties of iron itself. They themselves recognize the danger of this course arising from the fact that the analysis and previous history of the specimen was not in all cases fully stated, and from the further fact that the first hundredth per cent of an impurity may well exert a greater influence upon some, at least, of the properties of the metal than any subsequent hundredth per cent. They have done a good job, under the circumstances, as any one who has tried to find out for himself a reliable value of any property of iron will recognize.

These chapters emphasize the truth of what Abegg himself used to say, that on any page of his book he could find several subjects for doctor dissertations. A highly commendable new feature is that at the bottom of each page is printed the page number at which the literature references to that chapter are to be found.

Progress in Cement

ZEMENT. By *F. Wecke.* Verlag Theodor Steinkopff, Dresden. 96 pages. Price, 6M.

Reviewed by JOHAN NORVIG

UNDER the general heading "Technische Fortschrittsberichte" (Reports on Technical Developments), a series of pamphlets is being issued in Germany by Prof. Dr. B. Rassow in Leipzig. The object of these pamphlets is to give short, concise descriptions of the technique of each industry so that the reader can get a fair general idea of the process, without being confronted with the necessity of plowing through a large number of periodicals and manuals. It is hoped that these little books may be of special value to students who want to investigate a particular industry but who have neither the time to read nor the means to purchase the generally quite expensive, although more complete, text books.

As Vol. XXV, this treatise on cement gives a brief description of the chemistry involved, the principal machinery used, and the methods of testing. While Wecke's description of the process is very short it serves its purpose quite well and the references which it gives to patents and to specific articles which have appeared in the technical papers in the past, affords the student a chance to follow up his subject further if he wants to obtain detailed information.

Naturally, the machinery mentioned is specifically of German manufacture; also the references are mainly to German papers and magazines. This undoubtedly will result in its being passed up by the American student as not applicable to his purpose; furthermore, the fact that both the pamphlet and the references are in a foreign language will reduce its usefulness in this country. There is a possibility, however, that the idea which Prof. Rassow has developed in issuing this series of "Technical Development Reports" might be taken up in this country to good advantage for the prospective authors, the interested engineers, and students.

Recent Arrivals

PETROLEUM DEVELOPMENT AND TECHNOLOGY, 1931. Transactions of the American Institute of Mining and Metallurgical Engineers. Published by the Institute, New York City, 1931. 657 pages—Papers presented before the Petroleum Division at Tulsa and Los Angeles last October, and in New York this February.

FRIEND'S TEXTBOOK OF INORGANIC CHEMISTRY. Vol. 7, Part 2, Sulphur, Selenium, and Tellurium. By *Reece H. Vallance, Douglas F. Twiss,* and *Annie R. Russell.* J. B. Lippincott Co., Philadelphia, 1931. 420 pages. Price, $14—The distinguished editor of this series, J. Newton Friend, has now produced one of the most important remaining volumes of his series, which now needs only two volumes for completion.

SELECTIONS FROM RECENT LITERATURE

FIVE-STAGE EVAPORATOR. K. Schiebl. *Archiv für Wärmewirtschaft und Dampfkesselwesen,* July; pp. 205-9. In certain kinds of evaporator operation—e. g., in sugar refining—it is customary to utilize the steam from the liquid being evaporated, preheaters or vacuum pans or other equipment being supplied with heat from this source. But as the quantity of steam thus used is subject to variations, fluctuations in the boiling temperature occur in different stages, and uniformity of operation suffers accordingly. For example, when steam from sugar juice is used for heating vacuum pans, the cooling effect on the steam may be so great that hot steam must be supplied from another source, and operating economy may suffer rather than gain. A trial, therefore, was made on a five-stage evaporator with pressure regulators for controlling the boiling temperatures in the several stages. Four regulators were considered necessary; one each for controlling steam supply to the first and third stages, one for the steam withdrawn from the juice in the first stage, and one to control the shut-off. An independent regulator for controlling the density, and hence the evaporation, in the last stage was also provided. Performance of the evaporator, with these regulators functioning, was carefully checked by means of recording thermometers, one for each of the five stages. The trial was continued for nearly three months, with only three short shutdowns for cleaning. The results showed that the controlled operation greatly increased the uniformity of operating conditions, provided adequately for all heat utilization devices (especially for supplying the vacuum pan with steam from the evaporating juice), and effected a net decrease in fuel consumption.

HEAT EXCHANGER DESIGN. C. Bogaerts and P. Meyer. *Forschung auf dem Gebiete des Ingenieurwesens,* July; pp. 237-44. To follow the course of temperature changes in the fins of heat exchangers has hitherto been a matter of difficult and complicated calculations, even for simple cases under constant conditions of heat transfer and thermal conductivity. A new method of iterative calculation has now been applied to the problem, with the result that much simplification has been effected and direct calculations can be made even when limited to data of relative excess temperatures. Like relative figures obtain for all cases of like physical conditions, including like shape of the cooling fins. Experimental figures were obtained by measuring the surface temperatures on a cylinder, electrically heated from the inside and cooled by air streams of varying velocities in a wind tunnel. With this experimental equipment, the calculations made for fins of various sizes and shapes were checked against the actual performance of the fins. It was observed that the third dimension—namely, the length—of the cooling fin, is an influential factor in performance and must be duly considered. The iterative calculation method was therefore applied also to length calculations, as a part of the problem of optimum size and shape for maximum heat transfer effect. Diagrams, curve charts and mathematical equations are used to set forth the principles that were followed and the results obtained.

PROCESSING STARCH. E. Szego. *Bulletin de l'Association des Chimistes de Sucrerie,* June; pp. 268-74. In the production of starch, from potatoes or the like, it is generally held that the very fine-grained starch is inferior in quality and yield to the starch made up of larger particles. A careful experimental study of fine and coarse starches has revealed that the difference is not inherent, but arises in the processes of manufacture, and that starch of very small particle size actually has some points of superiority over the coarser product. The reason for the relatively low yield of fine-grained starch lies mainly in the greater difficulty of separating the fine particles from the liquid. The reason for the inferior quality is that the finer grains, with their relatively large surface area, are more sensitive to deteriorating influences than are the larger grains. One of the advantages of the finer particles is greater viscosity, on account of their greater water-absorbing capacity as compared with larger grains. With proper processing, the yield is actually greater, instead of less, for the finer starch. In order to derive the greatest possible benefit from these superior features of fine-grained starch, producers must solve certain problems of equipment and procedure in the making of starch. Centrifugal separation is recommended and could readily be adapted to the recovery of fine-grained starch, in high yields. To prevent loss in quality of fine starch, the first essential is to speed up the processing so that the starch suffers the least possible exposure to deleterious influences during processing. Extraction methods can be improved for this purpose, and considerable improvement could also be made by modern process control.

IMPREGNATING FIBROUS MATERIALS. E. A. Hauser. *Kautschuk,* May; pp. 89-94. Theoretically, a solution of an organic impregnating agent in an organic solvent should give better penetration, and hence more thorough impregnation, of fibrous materials than would an aqueous dispersion of the same material. Hence, rubber cements should be more effective in making coated and impregnated fabrics than natural latex or an artificial dispersion of rubber in water. Contrary to this, however, the statement repeatedly appears in literature and patents, from the earliest investigators down to the present, that latex will penetrate fabrics more readily than will a rubber cement, and hence that latex is a better impregnating agent. To settle this question, a critical experimental study of the subject has been made, using the best available microscopic technique in examining the treated fabric specimens. Tire cord was used for the tests, and experimental impregnations were made with latex, a stabilized latex mixed with a hydrocarbon solvent, and with rubber cements. An improved new method of microsectioning was used in preparing the test pieces for microscopic examination. It was found that the effect which is obtained with latex is not a true impregnation of the fabric; that is, the rubber does not actually penetrate the fiber. A considerable degree of actual penetration was observed in the case of rubber cements; and the latex containing an organic solvent was intermediate, giving some penetration, but less than the rubber cement. It is noteworthy, however, that substances having the effect of surface activation, added to latex, impart to it some penetrative power. Vulcanization increases the penetration in the case of rubber cements, but has little effect on the rubber from latex, in so far as penetration is concerned.

MAINTENANCE HAZARDS. J. Davidson Pratt. *Chemical Age,* May 23; pp. 460-1. Recommendations for British practice in avoiding accidents in the cleaning or repair of chemical plant equipment are stated and discussed. The principal considerations in working inside large vessels are to disconnect the vessel thoroughly from all possible sources of entry of dangerous matter (sealing the ends of all inlet pipes, or closing and locking the valves), and to test the interior of the vessel for explosive or toxic substances before the the work is begun. The Redwood vapor lamp is recommended for detecting explosive vapors; and white mice, for detecting toxic gases. When a vessel which has not been certified safe must be entered, the worker should wear a life belt and breathing apparatus, in charge of a competent attendant. Manholes in large vessels should be large enough not only for a man to enter but for easy and quick removal of an unconscious man. It is also recommended that vessels be provided with both top and bottom manholes, not only for safety reasons but for improved efficiency in cleaning or repair opera-

tions. In the repair of lead-lined apparatus, due attention must be given to the possibility of hydrogen formation by acid corrosion of the underlying metal where the lead lining is blistered or defective; explosions in vessels where this has occurred are likely to be especially violent. It is particularly urged that maintenance and repair men be thoroughly and fully instructed concerning the hazards they may encounter and the safety precautions which they should observe.

NON-SILICEOUS PORCELAIN. A Damiens. *Comptes rendus de L'Academie des Sciences*, May 18; pp. 1235-7. The need for a material which would withstand the attack of hydrofluoric acid or fluorine and their derivatives led to experiments with calcium fluoride. It was found, in the course of these experiments, that a material can be fabricated from pure calcium fluoride in such a way that it has many of the desirable properties of porcelain, with all the inertness of calcium fluoride to attack by fluorine or its compounds. The preferred composition for making the new porcelain is a mixture of natural calcium fluoride, 120 mesh (75 parts), and an artificial calcium fluoride (25 parts). It is made up to a paste in water, air dried, pressed, and dried at 100 deg. C.; in this state it can be shaped as desired. The firing temperature for a dense, impermeable porcelain product should be about 1,250 deg. C. The product is perfectly neutral, and has the same white, nearly translucent appearance as ordinary porcelain. Its resistance to thermal shock is excellent. It can be made up into apparatus of any desired shape, because shaped pieces can be joined perfectly by cementing with the original paste, drying and firing. Thus a new material is made available for heat-stable and acid-resisting ware. Another noteworthy result of the investigation is the method of agglomeration used in making the ware; this method is believed to be generally applicable to the making of plastic shapes from substances which are considered to be highly refractory in this respect.

VACUUM DISTILLATION. K. Fischer, *Chemische Fabrik*, May 27; pp. 238-41. In the design of vacuum distillation apparatus, the most important consideration is the proper proportioning and arrangement of the vaporizing, evacuating, and condensing units. Efficient heat transfer, high vacuum capacity, and ample condenser surface are essential. Auxiliary features, such as ebullition capillaries, foam arresters, and the like, are only minor details in the performance of the apparatus. There is, however, one accessory which has more than minor significance, especially in the higher temperature ranges in which vacuum distillation is practiced. This is the refrigeration-machine type of auxiliary cooler, used to enhance the condenser effect. A small machine, utilizing a circulating brine to give temperatures as low as 0 deg. C., is helpful in this connection, and may be essential in cases where distillation conditions are relatively unfavorable. Performance data and cost figures are given for evaporation of water and several organic solvents, using water, ice, or solid carbon dioxide as the cooling agent. Comparisons also are made between metals (rustless steel and copper) and glass for condenser tubing. In most cases, a thin-walled V_2A steel tube is to be preferred to copper, in spite of the better heat transfer behavior of copper, because the tube must be strong enough to hold the vacuum without collapsing. Glass is unsuitable unless the temperature gradient is sufficiently large to compensate for the slower heat transfer through glass, as compared with metal tubing.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Chemical Industry and Trade of Poland, by Clayton Lane. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 762; 10 cents.

Present Status of British Coal Industry, by John H. Bruins. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 764; 10 cents.

Italian Chemical Developments Portrayed by Montecatini Report in 1930, by Elizabeth Hume. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 349; mimeographed.

The Kaolin Minerals, by C. S. Ross and P. F. Kerr. U. S. Geological Survey Professional Paper 165-E; 15 cents.

Production statistics from 1929 Census of Mines and Quarries in preliminary mimeographed form for: Lead and zinc, basalt, granite, limestone, and gold and silver (lode mines).

Agglutinating, Coking, and By-Product Tests of Coals from Pierce County, Washington, by S. M. Marshall and B. M. Bird. Bureau of Mines Bulletin 336; 10 cents.

Relationship Between Oxidizability and Composition of Coal, by Wilfrid Francis and H. M. Morris. Bureau of Mines Bulletin 340; 10 cents.

Methods and Costs of Mining Quicksilver Ore at New Idria Mine, San Benito County, Calif., by W. R. Moorehead. Bureau of Mines Information Circular 6462; mimeographed.

Methods and Costs of Milling Feldspar at Minpro Plant, Tennessee Mineral Products Corp., Spruce Pine, N. C., by B. C. Burgess. Bureau of Mines Information Circular 6488; mimeographed.

Mining Methods and Costs at Metal Mines of United States, by Charles Will Wright. Bureau of Mines Information Circular 6503; mimeographed.

Zirconium, by E. P. Youngman. Two parts of a study issued by the Bureau of Mines as follows: Part I—General Information, issued as Information Circular 6455; Part II—Domestic and Foreign Deposits, issued as Information Circular 6456; mimeographed.

Thallium, by Alice V. Petar. Bureau of Mines Information Circular 6453; mimeographed.

Survey of Cracking Plants, Jan. 1, 1931, by G. R. Hopkins. Bureau of Mines Information Circular 6509; mimeographed.

Mineral Production Statistics for 1930—Separate pamphlets from the Bureau of Mines on: Fuel Briquets, by W. H. Young and J. M. Corse, 5 cents; and Carbon Black, by G. R. Hopkins and H. Backus, 5 cents.

Mineral Production Statistics for 1929—Separate Pamphlets From Bureau of Mines on: Asphalt and Related Bitumens, by A. H. Redfield, 10 cents; Petroleum, by G. R. Hopkins and A. B. Coons, 15 cents; and Zinc, by E. W. Pehrson, 10 cents.

Mineral Production Statistics for 1930—Preliminary mimeographed statements from Bureau of Mines on: Coke and byproducts, Pennsylvania anthracite, feldspar, asbestos, graphite, talc, platinum and allied metals, and masonry, natural, and puzzolan cements.

Federal Specifications, issued by Federal Standard Stock Catalogue Board as follows: Gypsum plaster, gypsum plaster-board, gypsum wall-board, and interior varnish; 5 cents each.

Chemical Industry and Trade of Portugal, by A. H. Swift. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 760; 10 cents.

Mineral Production Statistics for 1929—Separate pamphlets from the Bureau of Mines on: Mica, by B. H. Stoddard, 5 cents; Bauxite and Aluminum, by C. E. Julihn, 5 cents; Copper, by C. E. Julihn and H. M. Meyer, 10 cents; Lead and Zinc Pigments and Salts, by Elmer W. Pehrson, 5 cents; and Cement, by B. W. Bagley, 10 cents.

Development of Tartaric Acid Industry in Spain, by Katherine Elliott. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 341; mimeographed.

Swiss Dye Industry in 1930, by Albert W. Scott. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 342; mimeographed.

Tariff Commission Rules of Practice and Procedure. Second revision issued by the U. S. Tariff Commission; 10 cents.

Edible Gelatin. U. S. Tariff Commission Report to the President No. 13, Second Series.

Abrasive Grain Sizes. Bureau of Standards Simplified Practice Recommendation 118-30; 5 cents.

Standard Thicknesses, Weights, and Tolerances of Sheet Metal. Bureau of Standards Circular 391; 10 cents.

Bibliography on Dry Cleaning, by Alvin E. Johnson. Bureau of Foreign and Domestic Commerce Textile Maintenance Section Special Circular 613; mimeographed.

Federal Specifications. Issued by Federal Standard Stock Catalogue Board on: Foundry coke and calcined gypsum: 5 cents each.

Department of Commerce Publications. List of publications of the Department of Commerce, edition of May 15, 1931.

Miscellaneous Publications

Beginning Another Century. Philadelphia Quartz Co., Philadelphia, Pa., 1931. 33 pages—Handsome and attractive historical sketch of the company's fortune throughout its century of existence.

Standards and Specifications for Vulcanized Fibre. National Electric Manufacturers' Association, New York City. Bulletin 31-7. Price 25 cents.

Experimental Studies on the Production of Insulating Board From Cornstalks. By O. R. Sweeney and others. Bulletin 102, Iowa Engineering Experiment Station, Ames, Iowa. 64 pages—Results and description of experimental technology, with bibliography.

Useful Information About Lead. Lead Industries Association, New York City, 1931. 103 pages—Very neat and impressive bound booklet on the uses and properties of lead; attractively illustrated.

Chemistry and Industry. Special jubilee number, July, 1931. Journal of the Society of Chemical Industry, London, 1931. 272 pages. Price 10s.—This ambitious and comprehensive survey of British chemical history is in commemoration of the society's 50th anniversary. It is well illustrated and executed, speaking through the medium of biographies and reprints of important articles from the past.

Specific Gravity Basis for Determining Heating Value of Refinery Gas

By Frederick W. Isles

Bayway Refinery, Standard Oil Co. of New Jersey
Linden, N. J.

SOME YEARS AGO the writer drew up the accompanying curve, which gives graphically the relationship between the heating value and the specific gravity of refinery gas. It has proved to be so valuable that it is offered here for general use. Knowing only the specific gravity of a gas, one is often able to dispense with calorimeter readings in obtaining the B.t.u. value, or to approximate the average molecular formula of a gas mixture for use in combustion calculations.

Refinery gas consists largely of hydrocarbons of the paraffine and olefine series, the B.t.u. values and specific gravities of which are well known. These are listed in the accompanying table. When the values of both series are plotted, they are found to lie on practically straight lines. This means that, whatever may be the proportions of the individual hydrocarbons of either series in a mixture made up only of that series, the resultant B.t.u. value, when plotted against the specific gravity, will lie somewhere along the corresponding line.

Now if, as is the case with refinery gas, we have a mixture of paraffines and olefines, the B.t.u.-specific gravity point will lie between the two curves, which, fortunately, are close together. We may, without appreciable error, draw an intermediate curve representing the very approximate B.t.u.-specific gravity relationship for paraffine-olefine mixtures of the type of refinery gas. This is the line plotted.

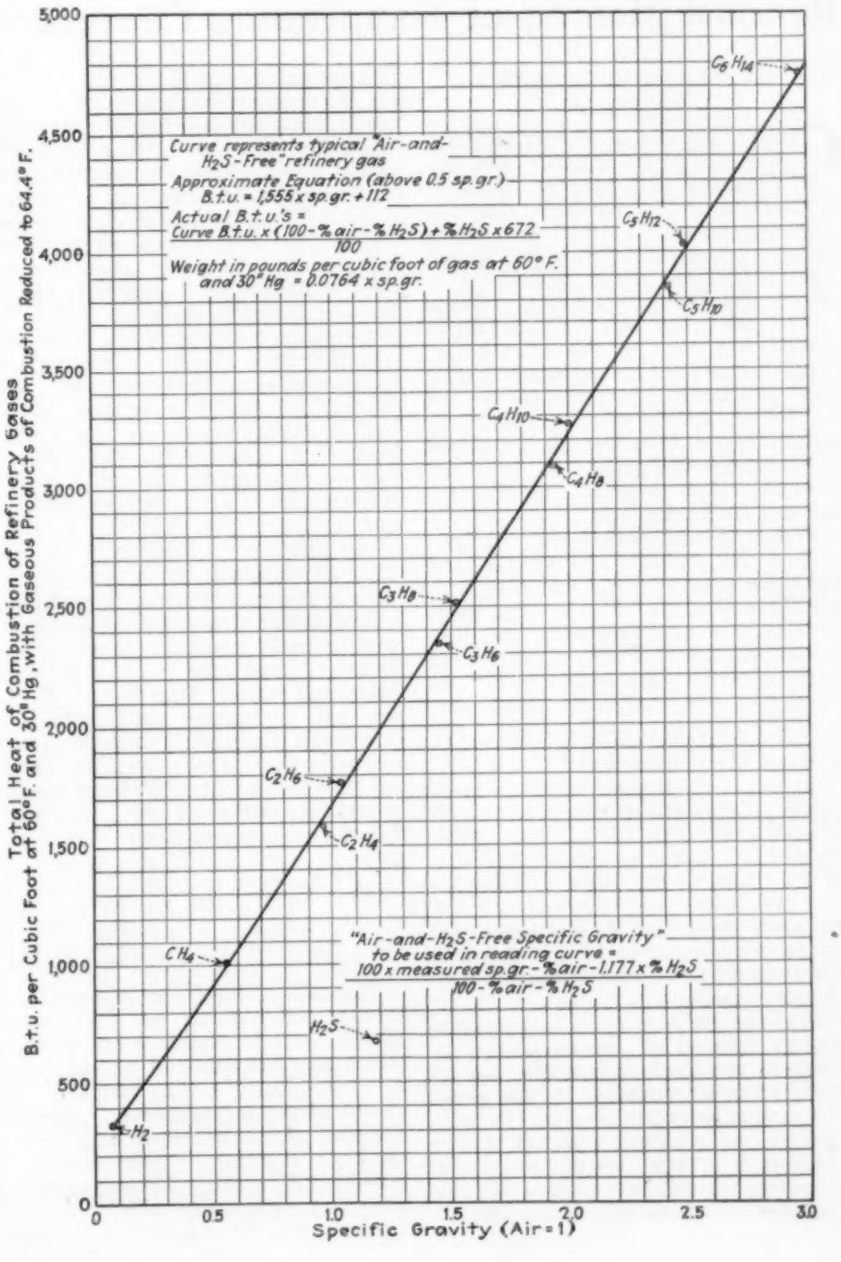
Heating Value and Specific Gravity of Refinery-Gas Constituents

(Data from Physical Tables)

Gas	B.t.u. Per Cubic Foot	Specific Gravity
CH_4	1,009	0.553
C_2H_6	1,764	1.037
C_3H_8	2,521	1.521
C_4H_{10}	3,274	2.005
C_5H_{12}	4,036	2.488
C_6H_{14}	4,760	2.972
C_2H_4	1,588	0.968
C_3H_6	2,347	1.451
C_4H_8	3,099	1.935
C_5H_{10}	3,847	2.419
H_2	326	0.069
H_2S	672	1.177

Again fortunately, the B.t.u.-specific gravity point for hydrogen, which may be present in large quantities in cracking-still gases, lies very nearly on the downward prolongation of the plotted line. Consequently, with hydrogen present in the quantity usually found in refinery still gases, the B.t.u.-specific gravity relationship will still be approximately represented by the curve.

It is clear, therefore, that this curve depicts, with an accuracy sufficient for



many engineering purposes, the B.t.u.-specific gravity relationship for typical air-and-H_2S-free refinery gas. The approximate equation of the curve, which affords a convenient way of committing the relationship to memory, is found for specific gravities above 0.5 to be

$$\text{B.t.u.} = 1{,}555 \times \text{sp.gr.} + 112.$$

This equation becomes increasingly applicable as the percentage of hydrogen in the gas decreases.

In using the curve, the specific gravity of the gas and its air and H_2S contents must be known. The air-and-H_2S-free specific gravity to be used in reading the curve equals:

$$\text{Air-and-}H_2S\text{-free sp.gr.} = \frac{100 \times \text{measured sp.gr.} - \%\ \text{air} - 1.177 \times \%\ H_2S}{100 - \%\ \text{air} - \%\ H_2S}$$

Having read from the curve the "air-and-H_2S-free B.t.u.'s" corresponding to the foregoing hypothetical gravity, calculate the actual heating value of the gas by means of the following formula:

$$\text{Actual B.t.u. per cubic foot} = \frac{\text{Curve B.t.u.} \times (100 - \%\ \text{air} - \%\ H_2S) + \%\ H_2S \times 672}{100}$$

Usually it is regarded as unnecessary to correct for the presence of H_2S, where the latter occurs to the extent of only a few per cent. Not infrequently, where pressure-still gases are concerned, both the air and H_2S contents are neglected and the curve is read directly, using the measured specific gravity, without the need for making any calculations at all.

▼ ▼

Rational Method of Temperature Conversion

By Kenneth D. Dodds
Bellevue, Pa.

Common use of several temperature scales in scientific and engineering work requires that there be means of readily translating temperatures on one scale to their equivalents on other scales. Centigrade and Kelvin temperatures are easily mutually convertible, but the changing of Centigrade to Fahrenheit, and vice versa, usually is troublesome, because the relation between them is not an extremely simple one. Whenever it is necessary to find the Kelvin equivalent of a Fahrenheit temperature, a procedure often followed in preference to learning an additional formula, is first to convert the Fahrenheit to Centigrade.

The number of methods that has been devised for equating Centigrade and Fahrenheit temperatures undoubtedly is a reflection of the difficulty that many persons have in remembering any particular formula. Some of the more common methods are based on relations which are expressed in the equations:

$F = 9/5\ (C + 32)$; $C = 5/9\ (F - 32)$

$F = 9/5\ (C + 40) - 40$; $C = 5/9\ (F + 40) - 40$

$^*F = 2\left(C + \frac{160 - C}{10}\right)$; $^*C = \frac{1}{2}\left(F - \frac{320 - F}{9}\right)$

In these formulas F represents any temperature indicated by a Fahrenheit thermometer and C the equivalent Centigrade reading.

It is not the purpose of this paper to enlarge upon either the advantages or faults of the above expressions, but instead to direct attention to the merits of the equation

$$\frac{F - 32}{180} = \frac{C}{100}$$

This formula is familiar to many people, but few seem to be aware that its unique worth is not so much the relation which is directly expressed as it is the fundamental relation which is implied. The equation is a particularized expression of the fact that the ratio of the difference between any temperature and the freezing point, to the range from freezing point to boiling point is independent of the thermometric scale on which the temperature is expressed, provided only that the fixed points of the various scales refer to the same substance. This relation can easily be verified, and in fact becomes practically self-evident when it is recalled that the effect of heat on temperature indicating devices is proportional to the intensity of molecular agitation; and that this intensity is not affected in any way by any arbitrary designations applied thereto.

Since the ratio previously mentioned is independent of temperature scales, the mathematical statement may be extended beyond the Centigrade and Fahrenheit scales. Thus if F, C, R, A_K, A_R, and Z denote the readings of Fahrenheit, Centigrade, Reamur, Kelvin (absolute Centigrade), Rankine (absolute Fahrenheit), and "Z" thermometers respectively, when all are in the same thermal environment, then

$$\frac{F - 32}{180} = \frac{C}{100} = \frac{R}{80} = \frac{A_K - 273}{100} = \frac{A_R - 460}{180} = \frac{Z - (\text{f.p.})\text{"Z"}}{(\text{b.p.})\text{"Z"} - (\text{f.p.})\text{"Z"}}$$

The "Z" scale of temperature is, of course, non-existent; but the term is adopted here to designate any scale on which the freezing and boiling points of water—i.e., (f.p.)"Z" and (b.p.)"Z" in the above formulas—are arbitrarily assigned any values desired. There is no limit, therefore, to the number of possible "Z" scales. The advantage of assuming such scales will be apparent in the fourth of the following examples, which illustrate the use of the foregoing general formula.

Example 1—What Fahrenheit temperature corresponds to —10 deg. C.?

Solution:

$$\frac{F - 32}{180} = \frac{C}{100},\ F = 14 \text{ deg.}$$

Example 2—What is the Kelvin equivalent of 60 deg. F.?

Solution:

$$\frac{A_K - 273}{100} = \frac{60 - 32}{180},\ A_K = 288.6 \text{ deg.}$$

Example 3—What would a Reamur thermometer read when a Fahrenheit thermometer indicates 18?

Solution:

$$\frac{R}{80} = \frac{18 - 32}{180},\ R = -6.2 \text{ deg.}$$

Example 4—What is the correct temperature indicated by 78 deg. on an incorrect Centigrade thermometer, which registered —0.52 deg. in melting ice and 99.1 deg. in steam under 760 mm. absolute pressure?

Solution: This thermometer may be regarded as having been graduated not on the Centigrade scale but according to a "Z" scale on which the fixed points are those found when the thermometer was tested.

Hence

$$\frac{C}{100} = \frac{78 - (-0.52)}{99.1 - (-0.52)},\ C = 78.8 \text{ deg.}$$

The reading of any inaccurate thermometer may be corrected in this way, or translated to a different scale without first finding the correct temperature on the scale according to which it was supposedly graduated. In this example, for instance, the incorrect Centigrade reading can be converted to correct Fahrenheit units directly:

$$\frac{F - 32}{180} = \frac{78 - (-0.52)}{99.1 - (-0.52)}$$

$$F = 173.9 \text{ deg.}$$

The relation about which these remarks center affords a ready means for finding the difference between two temperatures, on any scale, which is equivalent to a known difference on another scale. As an example, let C_1 and C_2 be any Centigrade temperatures, and F_1 and F_2 their Fahrenheit equivalents.

Then

$$\frac{C_1}{100} = \frac{F_1 - 32}{180}$$

$$\frac{C_2}{100} = \frac{F_2 - 32}{180}$$

$$C_1 - C_2 = \frac{100(F_1 - 32)}{180} - \frac{100(F_2 - 32)}{180}$$

$$= 5/9\ (F_1 - F_2).$$

Similarly $F_1 - F_2 = 9/5\ (C_1 - C_2)$.

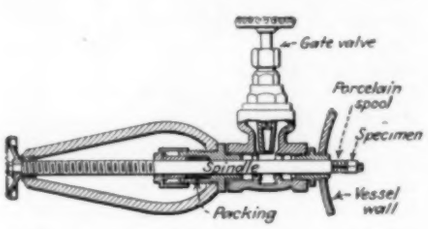
The advantage of the temperature conversion method described herein, over a collection of formulas each of which applies to only two scales, is that the one basic principle involved can at once be written as a formula to fit the particular case at hand.

*Wenzel, *J. Chem. Educ.*, April, 1931, pp. 727, 8.

EQUIPMENT NEWS
FROM MAKER AND USER

Corrosion Tester

QUICK TESTING of metals and alloys under actual operating conditions is the function of a new device recently developed by Cloyd M. Chapman, 105 West 40th St., New York City. The device, as shown in the accompanying drawing, consists of a yoke and stuffing box attached to a standard gate valve. This provides a means for projecting an alloy steel spindle through the valve and into the interior of the vessel in which the test is to be conducted. Specimens are attached to the end of the spindle by means of an alloy steel tap bolt. It is recommended that the specimen be of one of two types. One form consists of a small cube of the material, polished on opposite faces. This is attached to the spindle by means of the alloy steel bolt. In the other method, a fine wire of the material under test is wrapped on a special notched porcelain spool which is attached to the spindle. The spool is large enough to carry samples of four wires, making it possible to test several different materials at one time. When the test is completed, it is only necessary to withdraw the sample far enough so that the gate valve may be closed, whereupon the sample is removed entirely to permit visual or microscopic inspection.



Device for Corrosion Testing Under Pressure

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Pulp Beater Control

CONTINUOUS beating of paper pulp has been handicapped in the past, according to the Merritt Engineering & Sales Co., Lockport, N. Y., by the difficulty of maintaining the proper density in the beater. To overcome this difficulty, the company has devised a new controller which is known as the Meyers-Mesco automatic water feeder for beaters. Its operation depends on the fact that height of the stock on either side of the midfeather in the beater will differ, and this difference will depend in any given beater on the density of the stock. This fact suggested that the height difference could be used in controlling the dilution. For this purpose, the new controller makes use of a pressure pipe in each side of the beater. Air supplied at constant pressure bubbles continuously from the bottom of each pipe. Back pressure in the two pipes will then depend on the height of stock above the bottom of the pipes. The back pressures are measured by opposing bellows and this measurement is communicated by a linkage to a pilot valve. The pilot controls the movements of a piston in a hydraulic cylinder, and this, in turn, operates the dilution valve. Once the proper level difference has been determined, it is asserted that this controller is capable of regulating the dilution water supply continuously at the rate just sufficient to maintain the desired level difference and hence the proper dilution of the stock.

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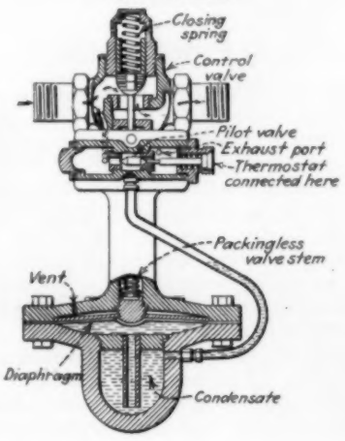
Temperature Regulator

ACCURATE on-and-off control of temperature is claimed by the Sarco Co., 183 Madison Ave., New York City, for its new Type TR-24 temperature regulator. This is of the non-indicating type and consists of two principal parts, a thermostat and a pilot-operated valve. The thermostat, which is the standard Sarco type, is not shown in the accompanying drawing. It consists of an adjustable temperature-responsive system filled with a heavy hydrocarbon oil, the bulb of the system being connected by capillary tubing to a cylinder containing a packingless piston made of a length of metal bellows. Motion of the latter, due to temperature changes, is communicated to the pilot mechanism of the valve at the point shown in the illustration.

Temperature Regulator in Open Position

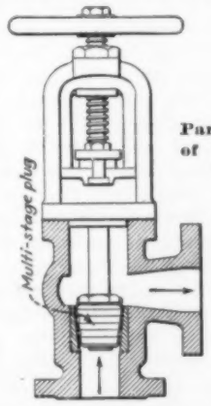


When the temperature of the bulb is below the set point, the pilot valve is open and the steam or other heating medium flows from the main valve through the pilot valve, down the tube, and forces the diaphragm upward. This opens the main valve against the pressure of its spring. As soon as the temperature has reached the set point, the pilot valve closes, the exhaust valve opens, the main valve is forced down by its spring, and the excess water under the diaphragm is discharged through the exhaust valve and out of the exhaust port. This regulator is available in sizes from ½ to 1½ in.

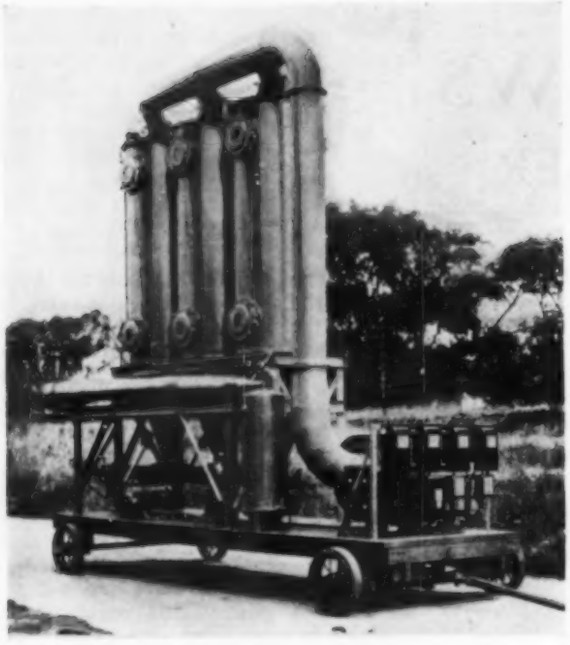
❖

Multi-Stage Valve

VALVE-SEAT EROSION is said to be completely eliminated in the Ludlow "Multi-Valve" recently announced by the Ludlow Valve Mfg. Co., Troy, N. Y. The novel feature of this valve is a special grooved plug which closes against a conical seat. This construction is indicated in the accompanying drawing. The design of the plug is such that each of the several land surfaces makes contact with the seat in the closed position. As the valve is opened, the fluid being handled is subjected to multi-stage expansion, passing as it does over the several lands and expanding into the several expansion chambers. Thus instead of a single seat, this valve employs five or more, depending on the conditions under which it is to operate. The manufacturer declares that this construction avoids all cutting and wire drawing, enables the valve to give accurate throttling control, avoids all possibility of scale becoming imbedded in the seat, and produces a valve which actually improves with use. The valve is available for a variety of liquids, gases and vapors, and is obtainable in sizes from ¾ to 3 in.



Partial Section of Multi-Stage Valve



Dust Collection Where You Want It

This portable, completely self-contained dust-collecting unit was recently designed by the Dust Recovering & Conveying Co., Cleveland, Ohio, for shipment to Russia. The unit consists of three standard Dracco filters mounted on a truck, with the exhauster and other auxiliary equipment. The intake is at the left, together with a nozzle for providing atmospheric air for cooling. Solids discharge to a screw conveyor beneath the filters, while cleaned air discharges through the exhauster at the right.

Compound Steam Trap

SIMPLE design, few moving parts, and high capacity are features of a new compound steam trap announced by the Armstrong Machine Works, 812 Maple St., Three Rivers, Mich. The new trap employs a pilot device to operate a large discharge valve and consists of two standard Armstrong trap bodies bolted to a central housing which contains a piston operating the discharge valve. The condensate enters the upper chamber, later passing through the discharge valve to the outlet pipe. A pilot tube extending to a point near the top of this chamber permits steam associated with the condensate to descend and enter a pilot bucket in the lower body. As soon as the condensate level has risen sufficiently, water flows down the pilot tube, condensing the steam in the pilot bucket, and causing the latter to drop. This opens a pilot valve and permits the pressure within the pilot chamber to act on a piston and open the discharge valve. When the water has discharged to a certain level, steam again enters the pilot tube and causes the pilot bucket to rise, thus closing the pilot valve and the main discharge valve.

The new trap is made of semi-steel containing nickel and chromium for pressures up to 250 lb., and one-piece forgings for higher pressures. It is available in sizes from 1 to 3 in.

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Portable Gas Analyzer

PORTABILITY and ease of use are incorporated in a new thermal-conductivity gas analyzer, recently introduced under the name of "Gasalyser" by Charles Engelhard, Inc., Chestnut St. and N. J. R.R. Ave., Newark, N. J. The instrument, which weighs less than 15 lb., consists of a box with a hinged cover, in the lower portion of which is a double-suspended type of galvanometer, calibrated in millivolts. The cover of the box contains a thermal-conductivity cell, a small hand pump for flushing out the cell, an absorption tube for analyzing ternary mixtures, and a panel on which the various control dials are mounted. The cover also contains the small dry-cell battery which supplies all the current needed for the analysis. Charts for determining single gases in various combinations of gases are available from the manufacturer. Terminals also are provided for connecting a thermocouple, for measuring temperature.

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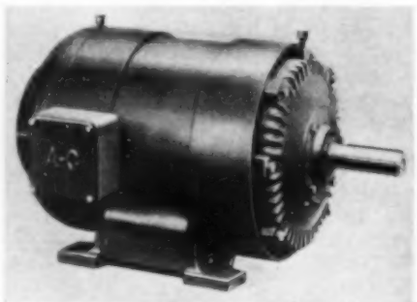


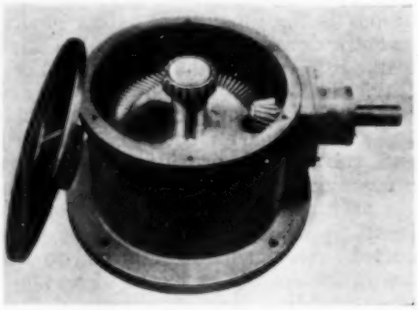
Motor for Class 1, Group D Applications

Explosion-Proof Motor

UNDERWRITERS' Laboratories has approved for Class 1, Group D locations a new line of explosion-proof motors announced by Allis-Chalmers Mfg. Co., Milwaukee, Wis. This motor is of the broad-flanged type, which prevents the escape of flame to the outer atmosphere, should the gas within the motor become ignited. Its special features include extra long bearings, special alloy-steel cap screws, and a special explosion-proof cast-iron conduit box. The motor is intended for use in oil refineries; gasoline plants; paint, varnish, and lacquer works, etc.

Vertical Speed Reducer

SPIRAL-BEVEL gears are used in a new vertical speed reducer announced by the D. O. James Mfg. Co., 1114 West Monroe St., Chicago. The gears are of chrome-nickel steel, cut with spiral bevel teeth for efficient, noiseless operation. For large ratios of reduction, this reducer is built integral with a planetary reducer so that all ratios from 8 to 1 to 1,600 to 1 are available. The reducers are made in sizes from ½ to 100 hp.



New Spiral-Bevel Vertical Speed Reducer

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Belt Conveyor Idlers

TROUGHING and return idlers, known as the new Series 40, and intended for belt conveyors, have recently been announced by the C. O. Bartlett & Snow Co., Cleveland, Ohio. The idlers are equipped with Timken roller bearings and are so designed that the pulley shells may be renewed without destroying the pulley ends. The troughing idlers are mounted in sets of three on four brackets, the open tops of which permit the quick and easy removal of any pulley. Lubrication is of the high-pressure type. These idlers are offered in nine sizes for belt widths ranging from 18 to 60 in.

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Flexible Coupling

FLEXIBLE coupling of small shafts up to 1 in. in diameter is accomplished by the new Morse Midget, recently placed on the market by the Morse Chain Co., Ithaca, N. Y. This is a miniature counterpart of the chain and sprocket coupling which this company has previously manufactured for installations up to 500 hp. The coupling consists of two small sprockets wrapped and held together by a chain which allows for a certain amount of misalignment and supplies an element of flexibility.

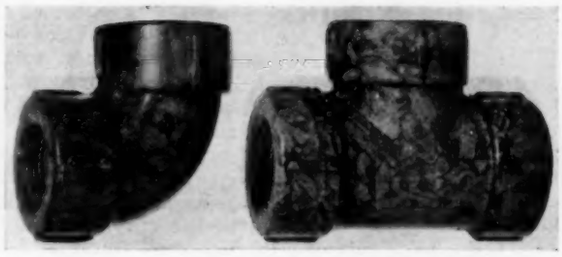
❖

Inside Polished Tubing

STAINLESS STEEL tubing in lengths up to 20 ft., with highly polished inside surfaces, is now supplied by the Globe Stainless Tube Co., Milwaukee, Wis. This product is said to be of value not only from the sanitary standpoint but because of the fact that polishing improves its corrosion resistance.

Non-Metallic Pipe And Fittings

CONTINENTAL Diamond Fibre Co., Newark, Del., has recently introduced a line of pipe and fittings molded of fabric-reinforced Dilecto. This is a thermo-setting plastic material which is resistant to acid corrosion, heat, and pressure. The pipe is made from machine-threaded tubing. The fittings, typical examples of which are shown in an accompanying illustration, are molded to shape and machine tapped. They are available for pressures up to 650 lb. and temperatures to 290 deg. F. The company is also prepared to supply fittings made of a different composition adapted to the resistance of alkalis.

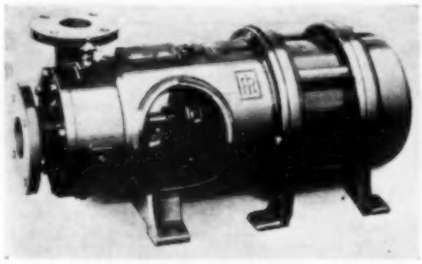


Dilecto Tee and Elbow

❖

General Service Pump

COMPACTNESS is a feature of the new Cameron general-service centrifugal pump, Class RV, recently announced by Ingersoll-Rand Co., 11 Broadway, New York City. As appears from the illustration, this pump is of the close-coupled type, making use of a minimum number of revolving parts and of bearings. The pump is intended for small- or medium-capacity service against moderate heads. It is available in six sizes.



Close-Coupled General-Service Pump

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V-Belt Drive Pulley

AMERICAN PULLEY CO., Philadelphia, Pa., has developed a line of pressed steel, multi-grooved pulleys for V-belt drives. These are formed in heavy dies, so accurately, according to the manufacturer, that machining is unnecessary. The result is said to be a product which has no abrasive action on the belt. The company is also prepared to supply grooved driven pulleys of cast iron, larger than its range of steel pulley sizes.

❖

Gage Protector

COMPLETE protection for all types of pressure gage under every operating condition is said to be assured with two new protection devices recently announced by Champion & Barber, Inc., 576 Subway Terminal Bldg., Los Angeles, Calif. The first device is a gage protector and the second a "Non-Pulsator." The protector consists of a bronze, acid-resistant fitting containing a rubber bulb filled with glycerine or castor oil for transmitting pressure to the gage. This is said effectively to prevent entrances of fluids or solids to the gage. The second device contains a restricted fluid passage, adjusted by means of a needle valve, which is said to eliminate all pulsation. Either device may be used separately, although the manufacturers recommend the more complete protection to be obtained through the use of both devices simultaneously on the same gage.

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Hot Oil Packing

A NEW GRADE of asbestos sheet packing, intended especially for use with hot oil, has been announced by the Diamond Rubber Co., Akron, Ohio. Due to special treatment which produces an extremely compact product, the new material is said to be especially resistant to oils and gasoline. Its failure pressure under the standard compression test is said to be 40,000 to 45,000 lb. This company also has developed a new belt dressing for rubber belts, said to contain no materials harmful to rubber or to the pulley. It is non-flammable and is claimed to retain its pulling power and tackiness for long periods.

Streamlined Hydrometer

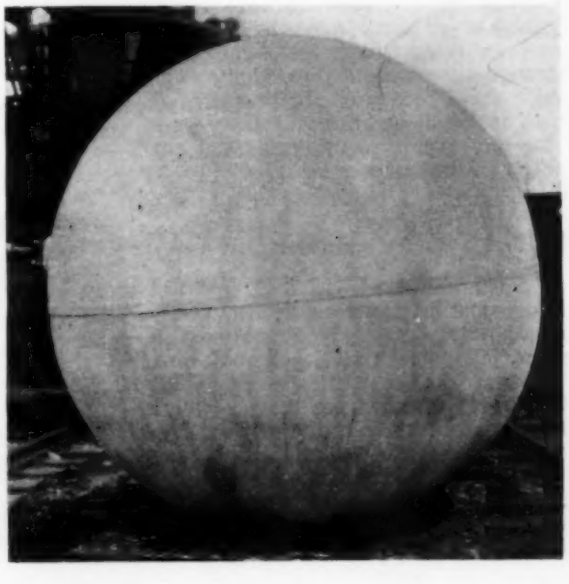
A TORPEDO-SHAPED tip is said to be an important feature of a new metal-ballasted hydrometer brought out by William Hiergesell & Sons, 295 Pearl St., New York City. The new hydrometer is unique in that the ballast metal is deposited by a special process inside the tip, forming a shell which adheres so closely to the glass that it can be removed only by smashing the glass and prying off the shell. Expansion and contraction due to changes in temperature are said to have no deleterious effects. This feature is said to increase accuracy, facilitate cleaning and reduce the possibility of breakage.

❖

Gyratory Sifter

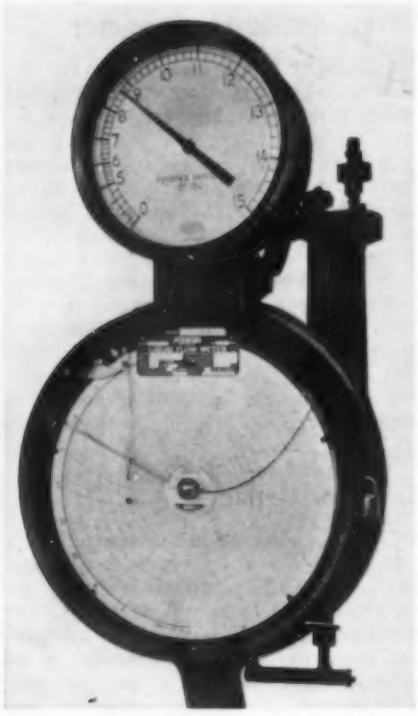
TRUE circulation motion of the entire screen surface is obtained in the new "Supersifter" recently put on the market by the Wolf Co., Chambersburg, Pa. This result is achieved by mounting the box containing the sieves directly over the gyrating mechanism so that the latter is connected to the box at its center. Thus, the entire weight of the sifter is carried on the gyrating mechanism, which is supplied with a combination of counterweights said to neutralize eccentric thrusts, eliminate vibration, and provide the sieve box with a smooth, rhythmic motion. All moving parts are equipped with ball and roller bearings.

To prevent blinding of the screens, rubber agitators of unique shape are supported on a sub-screen beneath each sieve, and these are kept in constant motion by the gyration of the screen. This type of construction is said to result in perfect stratifying action and rapid screening. The sieves, which are of silk or wire cloth, as desired, may be tilted at any angle from horizontal to 6 deg. Sifters are supplied with one to four screens, in sizes up to 40x87 in. This equipment is furnished for either motor or belt drive, and requires up to 1 hp., according to size.



Helium Storage Ball Tested to Destruction

One of a group of welded alloy-steel balls built by the A. O. Smith Corp., Milwaukee, Wis., for transporting and storing helium gas for the U. S. Navy. The ball is 7 ft. 10 in. in diameter. In testing it to destruction, it was first put under a pressure of 2,360 lb. and hammered pneumatically for 72 hours. Then under a pressure of 2,620 lb. it was struck with a 1-ton skull-cracker, dropping 23½ ft. Finally the pressure was raised to 5,700 lb. at which point destruction occurred.



Combination Instrument for Flow Measurement

Combination Instrument

RECORDING, integrating, and indicating of flow are available in a single instrument now being manufactured by The Foxboro Co., Foxboro, Mass. This consists of a standard recording and integrating instrument combined, as shown in the accompanying illustration, with an 8-in. indicator. The indicating scale is designed to be read at a considerable distance.

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Pressure Tank Gage

GAGING of liquid level in tanks containing liquid butane is possible with a new automatic tank gage developed by the Vapor Recovery Systems Co., 2820 North Alameda St., Compton, Calif. The contents of the tank is read in feet and inches at the ground or at some remote location, the readings being visible on a gage tape through a plate-glass window. The gages have been used for pressures as high as 250 lb. and are said to be available for varying requirements and any desired working pressure.

❖

Self-Aligning Bearing

A SELF-ALIGNING spherical mounting for a single heavy-duty Hyatt roller bearing is incorporated in a new pillow block developed by Sprout, Waldron & Co., Muncy, Pa. This bearing is intended for service where loads exceed those ordinarily met in line-shaft service. The self-aligning feature reduces bearing strain and is said to assure equal distribution of the bearing load along the total length of the rollers.

Insulating Firebrick

FOR LINING oil- and gas-fired furnaces, electric furnaces of the resistance type, and coal-fired equipment (where mechanical abrasion and slag action can be avoided), the Babcock & Wilcox Co., 85 Liberty St., New York City, has developed what is known as the B.&W. No. 80 insulating firebrick. This brick has a very low thermal conductivity—only 2.75 B.t.u. per square foot per inch of thickness per degree F. per hour at 2,000 deg. F.—while at the same time it is said to have refractory qualities which compare favorably with any high-grade firebrick. The brick is light, weighing only about one-fourth as much as fireclay brick; and being of low specific heat, it has small heat-storage capacity, a feature of importance, particularly in intermittent furnaces. The brick may be used without any protection other than a coating of high-temperature or patching cement.

❖

Mercury Column Gage

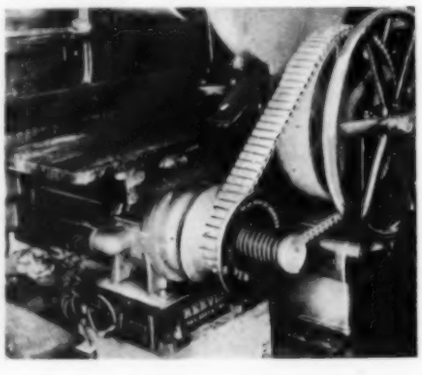
VACUUM and low pressures may be measured accurately, according to the Amthor Testing Instrument Co., 309 Johnson St., Brooklyn, N. Y., with a new mercury column gage of its manufacture. The mercury chamber of the pressure gage is provided with a right, left, and top connection, any one of which may be used. In instruments intended for vacuum, there is a top connection and a lower vent plug. The latter instrument is calibrated in inches of mercury and the former in various ranges for maximum pressures from 5 to 25 lb.

❖

Variable-Speed Drive

SIMPLICITY and ease of control are outstanding features of the new "Vari-Speed" motor pulley manufactured by the Reeves Pulley Co., Columbus, Ind. As is evident from the accompanying illustration, this pulley is mounted on the motor shaft and consists of two shallow conical disks which are forced together by a heavy spring. The disks are similar to those forming one of the pair of pulleys used in the standard Reeves drive. The drive belt is formed of tapered blocks with driving surfaces on the ends and also on the inner surfaces for contact with the driven pulley. A special motor base, capable of moving the motor forward or backward, forces the disks to spread or move closer together, thus varying the driving diameter. Drives are made in sizes ranging from fractional to 7½ hp. Speed control is infinite within a ratio limit of 3 to 1.

New "Vari-Speed" Motor Pulley



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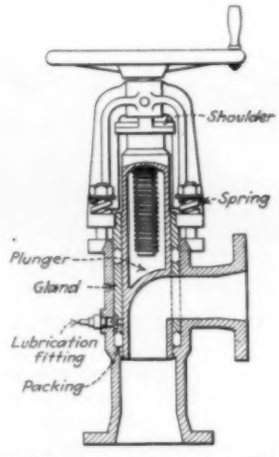
Improved Valves

TWO improved valves, one of the quick-opening and the other of the seatless type, have been announced by the Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa. The Type P seatless valve is illustrated in the accompanying drawing. It is shown in the open position with the plunger raised so as to present a smooth passage through the valve. When the valve is closed, the plunger descends until the shoulder at the top comes in contact with the upper section of the follower gland. The harder the handwheel is turned after the valve is closed, the tighter the valve becomes, due to compression of the packing both above and below the discharge opening. Springs are provided on the stud bolts to maintain the proper pressure on the packing when the plunger is in a position other than tight closed. Valves of this type are available in sizes from ¾ to 10 in. and in a variety of metals. Since the valve possesses no delicate seating surfaces, it is claimed to be especially suitable for viscous or solids-carrying liquids.

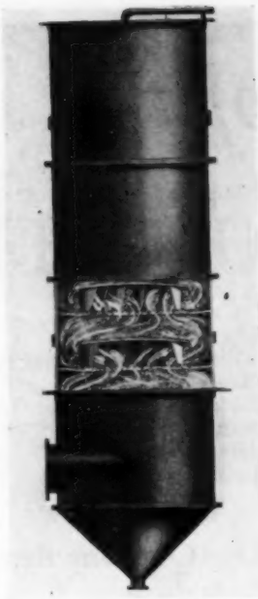


Partial Section of Seatless Valve

The second valve is of the lever-operated, swinging-gate type and is known as the "Pretite." This is a modification of the company's standard "double-tightening" valve, the improvement consisting in the use of a newly designed two-piece sealing bushing, which is held against the upstream side of the gate by spring pressure. Thus, the gate is in contact with seats on both sides during the entire opening and closing cycle. These valves are made in various materials and in sizes from ½ to 4 in.

Gas Washer

SEVERAL new features are incorporated in the new "Multi-Wash" dust collector, developed by Claude Schneible, 35 East Wacker Drive, Chicago, Ill. As appears in the accompanying illustration, this is a wet-type washer, in which the dust-laden gases or vapors enter tangentially at the bottom, passing upward and counter to the water or other liquid cleaning or absorbing medium. The spiral path of the gases is maintained throughout the travel by vanes which are attached to the several plates. Liquid, which is introduced at the top, falls in a spray through the succeeding plates of the tower, giving two washes per plate. Standard equipment provides six plates, or 12 washes. These collectors are adapted to the recovery of dusts, which if uncollected would create a nuisance; as well as the recovery of usable vapors or other valuable products.



Cutaway View of Wash-Type Dust Collector

Manufacturers' Latest Publications

Chemicals. Glyco Products Co., Bush Terminal Bldg. No. 5, Brooklyn, N. Y.—Booklet describing the use of a newly available soap, ammonium linoleate, in the preparation of emulsions.

Chemicals. Merck & Co., Rahway, N. J.—Leaflet describing the use of "Oxyquinoline Base CP" in the quantitative determination of aluminum, magnesium, and zinc.

Chemicals. Roessler & Hasslacher Chemical Co., 350 Fifth Ave., New York—New quarterly price list of chemicals made by this company.

Chemicals. U. S. Industrial Alcohol Co., 60 E. 42d St., New York—Chart of the "tree" type tracing the varied uses of industrial ethyl alcohol.

Control. American Radiator Co., 5842 Trumbull Ave., Detroit, Mich.—New price list of Mercoid controls, motor valves, solenoid valves, and electric gas valves made by this company.

Control. Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.—Bulletin 1212—8 pages on time-cycle contactors for process equipment.

Control. The Neilan Co., Ltd., 641 Santa Fe Ave., Los Angeles, Calif. — Bulletin 2000-B—20 pages on instruments and equipment made by this company for the recording and automatic control of pressure.

Dust Filters. W. W. Sly Mfg. Co., Cleveland, Ohio—Bulletin S-80—8 pages on a new dust filter made by this company, with illustrations and descriptions of typical installations.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-55C, Round-pattern switchboard instruments; GEA-61C, Constant-speed, direct-current motors; GEA-77D, Capacitors for power-factor correction; GEA-528A, Centrifugal air compressors, small, multi-stage; GEA-606C, 196-page catalog on industrial control equipment; GEA-702B, Automatic Telemetering equipment; GEA-712B, Adjustable-speed alternating-current motors; GEA-752A, Direct-current motors; GEA-857B, Outdoor fuse disconnecting switch; GEA-894, Adjustable-speed, direct-current motors; GEA-900C, Test blocks and plugs; GEA-912B, Ignition transformers for oil burners; GEA-937B, Price list on plastic products; GEA-957B, Mechanical-drive turbines; GEA-1096B, Indoor disconnecting switches; GEA-1114A, Solenoid-operated valve; GEA-1137A, Indoor a.-c. cubicles; GEA-1296A, Brake for d.-c. motors; GEA-1326A, Totally-inclosed, fan-cooled induction motors; GEA-1335, Turbine-generator sets; GEA-1341A, Explosion-proof induction motors; GEA-1360, Hinge-pipe fittings; GEA-1369, Outdoor horn-gap switches; GEA-1383, Squirrelcage induction motors; GEA-1393, Centrifugal air compressors; GEA-1412, Vertical induction Motors; GEA-1413, Electrical equipment for foundries; GEA-1414, Busbar clamps; GEA-1418, Pole-changing switches; GEA-1419, Combination magnetic switch; GEA-1423, Solenoid-operated valves; GEA-1433, Rectangular switchboard instruments; GEA-1437, Built-in speed reducers; GEC-98, Industrial heating devices; GES-402B, Motion pictures and illustrated lectures prepared by General Electric; GES-689, Applications of controllers.

Electrical Equipment. Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.—Circulars 1899 and 1915, covering respectively a detailed description of metal-inclosed switchgear; and a list of installations of this equipment.

Equipment. Babcock & Wilcox Co., 85 Liberty St., New York—Publications relating to tubular air heaters, quick-melting laboratory furnaces, refractory cements and plastics, insulating firebrick, and special process equipment supplied by this company.

Feeders. Galigher Co., 228 S. W. Temple St., Salt Lake City, Utah—15-page book illustrating and describing, and listing users of, the Geary feeder for liquids.

Fluid Handling. Semet-Solvay Engineering Corp., 40 Rector St., New York—Bulletin 44—48 pages on piping, flanges, valves, blast gates and cooling coils made by this company.

Gaskets. Victor Manufacturing & Gasket Co., 5750 Roosevelt Road, Chicago, Ill.—Catalog H—94-page catalog on metal and metal-asbestos gaskets, non-metallic gaskets and gasket materials, sheet packing and rod packings; includes engineering data.

Grinding. Patterson Foundry & Machine Co., E. Liverpool, Ohio—4-page folder describing and giving specifications on a new all-steel pebble mill made by this company.

Heating. W. S. Rockwell Co., 50 Church St., New York—Bulletin 294 and 317—Being respectively a 4-page discussion of the economics of industrial heating; and a description of a continuous conveyor-type annealing furnace for fuel or electric operation.

Instruments. Bacharach Industrial Instrument Co., 7000 Bennett St., Philadelphia, Pa.—Folder describing the use of the Maihak indicator in determining performance of gas compressors.

Instruments. The Brown Instrument Co., Philadelphia, Pa.—Two folders illustrating the principal features of the new potentiometer pyrometers made by this company.

Instruments. The Foxboro Co., Foxboro, Mass.—Publications as follows: Bulletin 173, 40 pages illustrating and describing liquid flow meters; Bulletin 174, 32 pages giving a quick survey of the entire line of controlling, recording, and indicating instruments for temperature, pressure, humidity, and flow made by this company; also leaflet illustrating the features of Foxboro recording thermometers.

Materials Handling. Fairfield Engineering Co., Marion, Ohio—100-page catalog on elevating and conveying machinery, including illustrations and installation diagrams.

Materials Handling. Fuller Co., Catasauqua, Pa.—Bulletin B-4—12-page pamphlet on unloading and conveying systems for bulk cement, making use of portable and standard Fuller-Kenyon pumps.

Materials Handling. Sandvik Conveyor Mfg. Co., 21 Amsterdam St., Newark, N. J.—Leaflet describing a steel conveyor belt which this company is now prepared to supply in widths up to 32 in., 8 in. wider than was formerly available.

Metal Protection. E. I. duPont de Nemours & Co., Wilmington, Del. — 19-page booklet describing research work in the development of a clear lacquer for metal protection, and the resulting new product, duPont 1130 Metal Lacquer.

Metals. Fansteel Products Co., North Chicago, Ill.—"Rare Metals," 1931 edition, 70 pages on the history, properties and uses of the tantalum, tungsten, molybdenum, caesium, rubidium, and columbium.

Metals and Alloys. Niagara Falls Smelting & Refining Corp., 2204 Elmwood Ave., Buffalo, N. Y.—48-page pocket booklet entitled "Facts for Foundrymen," giving information on various alloys supplied by this company.

Metals and Alloys. Republic Steel Corp., Massillon, Ohio—8-page folder describing the properties of Enduro Type FC Stainless steel, a free-cutting material with corrosion and heating resisting properties.

Power Transmission. W. A. Jones Foundry & Machine Co., 4401 W. Roosevelt Road, Chicago, Ill.—Description, data and other information on worm-gear speed reducers made by this company.

Power Transmission. Morse Chain Co., Ithaca, N. Y.—Bulletin 44—56 pages with engineering data and descriptions on silent-chain stock drives; includes information on selection and lubrication.

Pumps. Chicago Pump Co., 2336 Wolfram St., Chicago, Ill.—28-page catalog on the "Condo-Vac" vacuum pump, with explanation of vacuum production and data on sizes and specifications.

Pumps. Pomona Pump Co., Pomona, Calif.—Bulletin 16-A—32-page booklet illustrating and describing a complete line of water lubricated turbine pumps for deep wells. Profusely illustrated; includes tables of useful information.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: Specification sheet L-711-S3, 2-stage dry vacuum pumps; W-112-S15, horizontal duplex piston pumps for oil; W-310-S12A, centrifugal pumps; W-319-S3, centrifugal pumps.

Safety. Mine Safety Appliances Co., Pittsburgh, Pa.—Bulletins 76 and 77—Describing respectively the McCaa half-hour and two-hour oxygen breathing apparatus.

Sampling. The Galigher Co., 228 S.W. Temple St., Salt Lake City, Utah—19-page book, illustrating and describing, and listing users of, the Geary-Jennings sampler.

Screens. Ludlow-Saylor Wire Co., Newstead Ave. & Wabash R.R., St. Louis, Mo.—8-page booklet describing "Spring-Steel" coarse-mesh woven wire screen and listing about 250 grades and meshes.

Screens. John A. Roebling's Sons Co., Trenton, N. J.—72-page general catalog on wire cloth, wire netting, and wire screening for all purposes, including complete information on sizes and styles.

Steam Generation. Combustion Engineering Corp., 200 Madison Ave., New York—Catalog SG-1—20 pages completely describing this company's steam generators.

Stoneware. General Ceramics Co., 71 W. 35th St., New York—Leaflet describing "Pyrotone" and hard stoneware rolls made by this company.

Traps. W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa.—Bulletin 531—Folder on large-capacity industrial bellows steam traps for vacuum and pressures to 100 lb.

Tubing. Globe Stainless Tube Co., Milwaukee, Wis.—Bulletin 1-B—Chart of analyses of Stainless steels made by a number of companies; also shows typical forms in which tubing of these alloys can be produced by the Globe Stainless Tube Co.

Valves. The William Powell Co., Cincinnati, Ohio.—19-page booklet on corrosion-resistant valves with information on the materials from which these valves may be made. Includes properties and uses.

Water Treatment. Elgin Softener Corp., Elgin, Ill.—Bulletins describing respectively a system of continuous blow-down for boilers and this company's method of boiler water conditioning.

Welded Pipe. Taylor Forge & Pipe Works, P. O. Box 485, Chicago, Ill.—Catalog 31—88 pages with detailed data on forge welded pipe made by this company.

Welding. Lincoln Electric Co., Cleveland, Ohio—Application sheet on the design of arc-welded steel bases.

X-Ray. Robert W. Hunt Co., 2200 Insurance Exchange, Chicago, Ill. — 4-page folder announcing and describing this company's X-Ray service in the investigation of engineering materials.

NEWS *of the* INDUSTRY

Naval Stores Survey Will Be Made

BECAUSE of unsettled conditions which exist in the naval stores industry, the Department of Commerce has acceded to requests from the industry and will undertake a commercial survey. The survey will aim to obtain information on the quantity of both foreign and domestic turpentine entering consumption annually in this country and its chief uses. Naval stores factors and other large distributors will be asked to supply information on their principal customers during each month of the 1930-31 season, and the customers will then be asked how they used the product and their probable demands next year. In this way the industry will learn who uses its products, where these customers are located, what they use it for, and what times of the year they make their purchases.

The study is under the direction of G. R. Salisbury, in charge of the industrial marketing section of the Merchandising Research Division of the Bureau of Foreign and Domestic Commerce, in cooperation with the Chemical Division of that bureau. Although turpentine is the principal commodity, the survey will include data on other pine-tree products.

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Higher Freight Rates For Chemicals

RAILROADS have been authorized by the Interstate Commerce Commission to substitute carload and less-than-carload classification ratings for the any-quantity commodity rates that have applied on dyestuffs, chemicals, and acids from Trunk Line territory to the South for the past 25 years. The Commission held that the rate structure established as an aid to the then infant cotton textile industry has become antiquated.

As the old rates have been applicable to shipments in any quantity, the movement has been nearly all in less-than-carload lots. Under the new ratings, provisionally effective Oct. 14, there is a difference of as much as five classes on less-than-carload and carload shipments of the same commodity. The carriers have been ordered to cancel their proposed schedules without prejudice to the filing of tariffs conforming with the Commission's findings.

Rates on formic acid, oxalic acid, sodium phosphate, and tri-sodium phosphate, in carloads and less-than-carloads, from Chicago Heights, Ill., to Southern destinations, were found unduly prejudicial and in certain particulars unreasonable.

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Dye Company Reorganized In Italy

A REPORT from Trade Commissioner Elizabeth Humes at Rome states that at a recent board meeting of the Montecatini, the report was confirmed that a new company has been formed, which will go under the name of "A.C.N.A." but while the old "A.C.N.A." stood for "Aziende Chimica Nazionale Associate," the dyestuffs and explosive subsidiary of the former Italgas group, these letters now denote the new company, "Aziende Colori Nazionali Affini." The new A.C.N.A. will be capitalized at 60,000,000 lire, held jointly by the Montecatini and the I.G. Farbenindustrie group.

The new company will continue to operate the former A.C.N.A. plants at Rho, Ceasno Maderno, and Cengio. A new company, known as the Societa Chimica Nazionale has been formed to operate the plants at Bussi, in which various products connected with national defence are to be developed. For this reason the stock of the Societa Chimica Nazionale is entirely in the hands of the Montecatini and the operations in this section will be tied up with the experiments on new products which are being carried out by the Societa Dinamite Nobel of the Montecatini group.

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Aviation Interests Oppose Helium Exports

UTILIZATION of the nation's helium monopoly to obtain control of future interoceanic airship services was advocated at the annual meeting of the National Aeronautical Association in Washington on July 23-24. Opposition was expressed to proposals for permitting the unrestricted exportation of helium. At present, the government's approval is necessary before any helium can be shipped out of the country. It was brought out that the removal of this restriction would deprive the United States of its bargaining power in working out agreements with foreign airship services for the proration of services.

A.C.S. Buffalo Meeting Attracts Interest

BECAUSE of the importance of the chemical industry along the Niagara frontier, more than usual interest is shown in the eighty-second meeting of the American Chemical Society, which will open at Buffalo on Aug. 30 and continue through Sept. 4. A committee from the Western New York section of the society has been working for over a year to round out a program which will attract the interest of all who attend. Practically all the divisional meetings will be held in the Hotel Statler. The Division of Rubber Chemistry will meet at the Hotel Lafayette and the Division of Chemical Education will use the Y.M.C.A.

The Division of Petroleum Chemistry will hold a joint symposium with the Division of Gas and Fuel Chemistry and the Division of Industrial and Engineering Chemistry on the "Utilization of Gaseous Hydrocarbons." Donald B. Keyes will act as chairman of this symposium. The division will hold two additional sessions for miscellaneous papers.

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Graduate Courses in Fuel Technology

ANNOUNCEMENT is made by Columbia University that evening courses in fuel technology will be conducted at the university during the coming year.

These courses are designed to meet the growing demand for instruction of engineers in fuel technology. They aim to treat from the chemical engineering standpoint, and in a post-graduate manner, the applications of scientific principles in the production, distribution, and utilization of solid, liquid, and gaseous fuels.

The subject matter is introduced mainly by assigned readings in textbooks and in technical periodicals. The classroom periods are used for lecture and class discussions of the material in the assigned readings and of problems involving calculation and design, which will have a prominent place in these courses.

The courses are open to qualified graduate students on the approval of the instructor and will be given by Jerome J. Morgan, Ph.D., associate professor of chemical engineering, Columbia University.

Muscle Shoals Bids Opened Sept. 1.

THE Muscle Shoals Commission has sent out invitations for the leasing and operating the Muscle Shoals property. Bids are returnable to the commission on Sept. 1 and nearly 140 concerns have been asked to submit bids, these concerns including some of the largest industrial companies in the country as well as three farm organizations.

It is stipulated that the proposals submitted must have in view a type of operation in the interest of fertilizer production and of agriculture.

It had been announced earlier in the month that proposals for the disposition of Muscle Shoals would be sought and Colonel Joseph I. McMullin a member of the commission who announced the issuance of the invitations stated that no detailed bids could be expected at this time but that general proposals would lay the ground work for negotiating the terms of a definite bid. The commission will in turn recommend such a bid to the President or it may simply ask for general authority to effect a lease.

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Electrochemists Complete Salt Lake Program

ARRANGEMENTS have been completed for the meeting of the Electrochemical Society which will be held in Salt Lake City, Utah, Sept. 2-5. The technical program will open on the afternoon of Sept. 2 with a session on "Cyanides in Metallurgy," under the direction of Dr. Dorsey A. Lyon, of the University of Utah. A trip to the mouth of Little Cottonwood and the Whitmore plant with a dance at the Old Mill Club will complete the day's program. On Sept. 3, President Bradley Stoughton will conduct a session on "Electric Furnace and Deposition." Luncheon will include a round-table discussion on "Silver." Buses will leave in the afternoon for Mount Timpanogos. The Acheson medal will be presented to Dr. E. F. Northrup in the evening. On Sept. 4, members and guests will leave for a trip to the Utah Copper Mine and mills at Magna, after which the Garfield smelter and Saltair will be visited. The final session, on Sept. 5, will consist of a symposium on "The Physical Chemistry of Flotation," led by Prof. A. M. Gaudin, of Montana School of Mines.

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Sulphur Company Claims Salt Deposits

SUIT for the recovery of $5,770,440 from the Jefferson Island Salt Mining Co., Inc., represented as the value of salt illegally taken from the deposit beneath the bed of Lake Peigneur, near Delcambre, La., was filed in the district court at New Iberia on July 30, by the State of Louisiana and the Jefferson Lake Oil Co., Inc. The plaintiffs contend, in their joint petition, that the State of Louisiana is the owner of the salt deposit, which is under lease to the Jefferson Lake Oil Co. It is alleged by them that a total of 471,305 tons of salt valued at $8.00 per ton was extracted by the defendant from beneath the bed of the lake prior to May 1, 1931.

The Jefferson Lake Oil Co. has recently centered its efforts on the development of sulphur deposits found in Lake Peigneur.

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Du Pont Acquires Dye Trade of Newport

NOTIFICATION has been given to the trade that E. I. du Pont de Nemours & Co. has entered into an agreement to purchase the dyestuffs and chemical business of the Newport Co. subject to the approval of the stockholders of the latter. The wood distillates division of the Newport Co. does not figure in the transaction.

The Newport Co. plants involved are at Carrolville, Wis.; New Brunswick, N. J.; and Passaic, N. J. It is the intention that this additional dyestuffs and organic chemical business shall be consolidated with the dyestuffs business of the du Pont Company.

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Sulphur Production Down In Second Quarter

ADVICES from Texas state that production of sulphur in that state during the quarter ended June 30, 1931, amounted to 608,730 tons, compared with 649,594 tons in the previous quarter and 711,966 tons in the second quarter of 1930.

The Texas Gulf Sulphur Co., from its Matagorda and Wharton County fields produced 374,049 tons, compared with 403,684 tons in the previous quarter and 490,930 tons in the like 1930 quarter.

The Freeport Texas Sulphur Co. in Brazoria County produced 223,620 tons, against 234,105 tons in the quarter ended March 31, 1931, and 209,790 tons in the quarter ended June 30, 1930.

Duval Texas Sulphur Co. in Duval County, produced 11,061 tons, as contrasted with 11,805 tons in the previous quarter and 11,246 tons in the like quarter a year ago.

Paint Trade Acts to Stop Bribery

IN ITS efforts to stamp out commercial bribery, the paint and varnish industry is invoking the criminal as well as the civil law. James Dillard, of Greensboro, N. C., was indicted July 7 by the grand jury of Henry County, Va., for violation of the state law which prohibits "corruptly influencing agents, servants, and employees." Dillard's indictment followed an investigation by the commonwealth attorney of Henry County at the request of the unfair competition bureau of the paint and varnish industry. Dillard is the same man who is named as a co-defendant with Gilbert Spruance Co., of Philadelphia, in a pending complaint brought by the Federal Trade Commission alleging commercial bribery.

The statutes of 16 states dub commercial bribery as a criminal offense and the unfair competition bureau's diligent efforts to cast this evil out of the industry may lead to the prosecution of other salesmen. The bureau's police activities are carried on without fear or favor. Gilbert Spruance Co. and the Cook Paint & Varnish Co., of Kansas City, also cited in a recent complaint by the Federal Trade Commission, have been members of the American Paint & Varnish Manufacturers' Association for years.

On the face of the Commission's records it would appear that commercial bribery is more widespread in the paint industry than in any other. The large number of cases is explained, however, by the industry's persistent campaign against the practice. The Commission's docket indicates that no other industry has sought its cooperation in eliminating unfair practices of competition to anywhere near the same extent. The bribery evil is most acute in industrial sales. Foremen of plants consuming large quantities of paint products receive from the manufacturer, through the medium of his salesman, a regular percentage on all sales. This practice not only raises a bar against free and fair competition but involves economic waste, as foremen getting gratuities are inclined to call for the purchase of more paint than is needed.

On Sept. 7, The Braun Corporation will move into its new building at Los Angeles, Cal., which satisfies modern construction demands for office facilities, manufacture of chemicals, shipping and storage. Standing on a site covering two acres, it is a forceful argument in favor of sightly industrial architecture.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

IN THE desperate struggle between Germany and Chile for a larger share of the world's nitrate market, the United States has been almost completely ignored. Engrossed by the negotiations directed toward reestablishment of the international cartel, the other producing countries seem to have entirely overlooked the fact that the future policy of the United States is a more vital factor in the situation than any other.

The United States has developed plants that probably can produce nitrogen more economically than that of any other country. While at present plant operations have been greatly curtailed, it is interesting to consider what would happen to Germany, Chile, and Great Britain if American producers should decide to engage in an active production and worldwide sales campaign.

The I.G. is the biggest business entity in Germany. Nitrogen is the most important product on its schedule. Disruption of that branch of its business would retard Germany's struggle to regain economic equilibrium. At present the I.G. is just scraping by. Its nitrogen plants dating back to the World War are not modern and costs of operation are high. The I.G.'s business in the future may depend upon the terms that she can elicit from other producing countries.

Chile, through Cosach, is absolutely dependent upon nitrogen. Cosach can produce at cheaper prices if necessary, but in the event of a world war in nitrogen, the prospect is that American manufacturers could at least meet competition in the world market. This would be of serious consequence not only to Germany and Chile but to Great Britain, as Imperial Chemical Industries, Ltd., is one of the greatest British industrial enterprises.

THE collapse of cartel negotiations at Brussels on July 28 has been followed by a protectionist movement among the countries seeking to strengthen their hand in any subsequent negotiations for reviving the cartel. Duties imposed by Germany from July 15 strike principally at Chilean nitrate. Germany's import embargo policy is interpreted as indicating that in future the I.G. will supply export demand from the Norsk Hydro plant in Norway and maintain its old war-time plants to meet the requirements of the home market.

German business and shipping interests are disturbed by the embargo, anticipating that it will have an adverse affect on German export trade with Chile. Chile's temper is indicated by the report that her commercial treaty with Germany will be denounced. Reports received to Aug. 5 stated that Chilean representatives in Paris will attempt to negotiate separate agreements with all the European synthetic nitrogen producing countries with the exception of Germany.

Germany's request during the conference at Brussels that France, Belgium, the Netherlands, and Denmark restrict importation of Chilean nitrate was rejected. Since then Belgium has established an import license system similar to that of France. Poland is following suit and Italy is imposing protectionist duties.

At best, the failure of negotiations that in recent weeks have shifted from Paris to Lucerne and Brussels forecast a price war in the world market and diminished profits for all producing countries dependent upon export business. In the United States nitrogenous products are duty free and prices on imported sulphate of ammonia have already dropped to such an extent that the American Iron & Steel Institute has requested the Treasury Department to investigate with a view to issuance of an anti-dumping order.

Senator Harris, of Georgia, has protested that imposition of an anti-dumping duty would increase the price of fertilizer to farmers in the South. He has urged Seymour Lowman, Assistant Secretary of the Treasury, and F. X. A. Eble, Commissioner of Customs, to bring their investigation to a conclusion as quickly as possible, because manufacturers importing sulphate of ammonia now are required to put up a bond that a duty representing the difference between the home market price and the declared value on shipments to this country will be paid if dumping is found to exist. It is probable that several weeks will elapse before the Bureau of Customs issues its finding.

A SOUTHERN bank has a lot of leaky collateral for its $1,500,000 loan last May to the Gum Turpentine & Rosin Marketing Association. Turpentine finds its way through a crack quicker than water. Nineteen thousand of the 63,000 bbl. which the bank is holding are wood, and turpentine worth 32c. a gallon is leaking all over the floor in warehouses at Savannah, Brunswick, Jacksonville, and Pensacola.

The bank will soon have to decide whether to transfer its spirits to storage tanks and hold it for a rise in price or dump it on the market for what it will bring. Little credence is placed in reports that the bank has been accepting bids for the pledged product.

Since the bank advanced 65 per cent on warehouse receipts to the cooperative association three months ago, the price of turpentine has dropped from 50c. to 32c. a gallon. The loans now are equivalent to 100 per cent of present market value; perhaps a little less if average prices were used as a basis for advances. The bank's collateral also includes 233,000 bbl. of rosin on which the price has dropped from $5 to $3 a barrel.

Unable to meet the bank's demand for $400,000 or more collateral, the cooperative association ceased to function July 1, with at least 65 per cent of the crop still to be marketed. One glance at quotations since then tells the story of the demoralization of the market. Desperate, cooperative leaders presented a futile plea to the Federal Farm Board for a supplemental advance of 15 per cent.

AS PRODUCERS who joined the association got only the 65 per cent which the bank advanced, independents who figured last spring that a low price paid in cash was better than a gamble on the "stabilized" price at 50c. are better off today. For a time it seemed that the cooperative would be successful in establishing control of the market but the enterprise was defeated by a continued slack demand intensified by the economic prostration of Germany. Antagonism within the industry also helped to down the cooperative. Attempts to line up all factorage houses failed. The association represents at best only 60 per cent of production and its resources were exhausted in attempting to absorb independent offerings much larger than expected.

Both domestic and foreign demand have been attracted by bargain-day prices following collapse of the cooperative, but at 124,000 bbl. stocks of turpentine are 138 per cent larger than a year ago, and of rosin at 450,000 bbl., 83 per cent higher so the statistical position is not reassuring.

Distress in the industry may serve further to curtail production that is now running from 8 to 10 per cent lower than last year. Negro workers who must chip 1,000 "boxes" to earn 60c. a day will desert the woods for the cotton fields when picking starts. Prominent factors have notified producers to stop drawing drafts for payrolls, assuring them that food rations for themselves and their employees would be continued.

At the request of the Pine Institute of America, the Commerce Department is making a survey to determine the probable trend of consumption of turpentine and rosin. The competition of mineral spirits and other substitutes is keener every year.

Sensing the antagonism of consumers who had to pay dear in previous years, wise heads in the naval stores industry embarked on a program of research to develop new uses. This has lagged because of the lack of financial support, but even so, the future may prove that such a program will be more beneficial than the Act of Congress March 4, 1931, which defines gum spirits of turpentine and gum rosin as agricultural commodities and lured producers into thinking that in qualifying for "farm relief" their troubles were over.

Growth of British Chemical Industry Reviewed at Jubilee Meeting

Exhibition of Chemical Plants Attracted Wide Attention

From Our London Correspondent

WITH THE close of the jubilee meeting of the Society of Chemical Industry the "captains and the kings" all seem to have departed on vacation or to the sterner tasks which the present grave international situation is imposing upon all.

The presidential address of Sir Harry McGowan, chairman of I.C.I., published in *Chemistry & Industry* of July 17, is worthy of the closest study. As a thoughtful and far-seeing essay on present commercial and technical trends, flavored with acute political thought, it may well be referred to as the basis of future international chemical and commercial understandings. In general the addresses delivered during the meeting were not merely prepared speeches but definitely had the imprint of the speakers' personalities and gave viewpoints from a new angle. During the past fifty years, Sir Harry said, the national income has increased by about 100 per cent, that also being the increase in the total international trade of the country. Allowing for the increase in population, the income per head has increased by 33 per cent, and it is of particular interest to note that the exports of British chemical industries during that period have increased by no less than 94 per cent, as compared with only 53 per cent for all descriptions of British exports.

ULTIMATE effect of international trade, industrial cooperation, and economic nationalism will gradually, in Sir Harry McGowan's view, lead not only to the closest team work in British industry and in the British Empire but to an extension of international marketing and manufacturing understandings, the value and benefit of which are being increasingly recognized as the result of the experience of the last ten years.

Dr. Levinstein, who was presented with the medal of the Society of Chemical Industry, gave one of the brilliant and fascinating addresses which one is accustomed to expect from him, and dealing with obviously intimate and sympathetic knowledge of its past history, and with the dyestuffs industry and its development and progress in this country. Since this address was delivered, members of the Colour Users' Association at their annual meeting, have criticised some of Dr. Levinstein's views, particularly the statement that in the past there was no marked inclination on the part of British consumers to give preference to British-made products when prices and qualities were equal. There is no need to take too much notice of this age-long controversy, and similarly the address of Dr. G. Engi, of the Society of Chemical Industry ("CIBA") at Basle, Switzerland, was mainly of interest to those in the dyestuffs trade. Dr Engi, on the other hand, created a favorable impression and is typical of the modern executive with scientific attainments. The same might be said of Dr. Heinrich Schicht, who was another visitor to receive honorary membership, but the outstanding personality in this connection undoubtedly was Dr. Charles L. Parsons, who was received and eulogized to some extent also as the representative of American chemists. Among other visitors from the United States might be mentioned Prof. Jackson, of Columbia University; Prof. H. R. Moody, Dr. Foster Dee Snell, Dr. Duggan, who is an original member of the society, and a fairly large contingent from Canada.

THE exhibition of British chemical plants was certainly the best thing of its kind that we have seen in this country, and called forth favorable comment even from Dr. Buchner and Dr. Brettschneider, who came over specially as representing the Achema of Germany, which is the organization responsible for the chemical plant exhibition held in that country. The *Chemical Age* of July 11 has a very full description of the British Chemical Plant Exhibition, and in these notes it may suffice to refer to a new type of dryer made by the Kestner Evaporator & Engineering Co., and known as the E.M.S. dryer. The writer was immediately struck by the fact that it bore all the characteristics of the Salerni retort for low-temperature carbonization, and inquiries soon showed that the initials E.M.S., are those of Dr. Salerni. This dryer is particularly applicable to semi-dry granular products and to filter press cakes, and can be heated by the Merrill system of hot oil circulation. The exhibits of the Clean Coal Co., Ltd., operating the Lessing processes, the various aluminum firms, and some improved filter and evaporator units attracted attention.

Among the visits to the various works and research stations, the new laboratories of the Distillers' Co. were of particular interest, and it seems clear that with increased prices and taxation, coupled with the reduced consumption of potable spirits, such concerns are looking well ahead and exploring new fields of an obviously profitable nature, and on lines similar to those which proved so successful in the United States. Among investigations which have not yet proved feasible might be mentioned the manufacture of molasses and alcohol from sawdust, using sulphuric acid, the problem really being the cheap acquisition of adequate quantities of cellulosic material near the site of the plant. The Distillers' Co. has, through a subsidiary, been making dry ice for some years, and recently these activities have been greatly extended, owing to the availability of byproduct carbon dioxide from fermentation processes. At one of the functions blocks of dry ice were placed in the ballroom; these emanated from the new Carba plant which has just been installed at Billingham by Imperial Chemical Industries. The final evening function was a brilliant dance and entertainment at Imperial Chemical House, the whole of which was thrown open to inspection. The ballroom is normally the refectory and will accommodate 1,000 people, the kitchens being quite unique, as are also the magnificent suite of directors' rooms, which were universal admired by the visitors.

The international nitrogen situation continues to be rather obscure, and of course it is particularly unfortunate that the Chile interests could not fall into line with the obvious desire of the European synthetic producers to continue the agreement which expired last month. It seems inevitable that there will be a reduction in price and a concerted reduction in the output of the synthetic producers.

Reference was made last month to Prof. Teatini's process for sugar purification, using liquid sulphur dioxide. In a further lengthy contribution on this subject read at the Colonial Exhibition in Paris on July 7, Teatini deals very comprehensively and in a really brilliant manner with recent developments and improvements. It is understood that the Prix La Feuille has been awarded to Prof. Teatini in recognition of his services rendered to the sugar industry.

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Production of Chemicals In Russia

THE gross output of the chemical industries of the Soviet Russia for the year 1929-30 increased 34 per cent in comparison with the preceding year, as shown in the table below:

	1928–29 Rubles	1929–30 Rubles
Heavy chemicals	104,104,000	145,403,000
Coal tar products	23,168,000	27,569,000
Aniline dye industry	42,509,000	59,606,000
Naval stores	14,725,000	20,249,000
Paints and varnishes	53,337,000	78,323,000
Bones and byproducts	16,309,000	18,524,000
Oils, cosmetics, and fats	214,683,000	255,958,000
Match industry	42,535,000	57,289,000
Drug and fine chemical products	42,202,000	63,074,000
Miscellaneous	31,435,000	60,527,000
Total	585,007,000	786,522,000

Nominal value of one ruble equals $0.51 United States currency.

Of the various chemicals, increased production was outstanding in potassium carbonate, sodium sulphate, salt cake, aluminum sulphate, copperas, sodium and potassium bichromate.

Alkali Prices Lowered By Leading French Producer

New French Company Will Make Carbonate of Potash

From Our Paris Correspondent

THE PRESENT situation of the chemical French trade is not favorable, the yearly slump having started earlier than in previous years. Transactions are restricted, many firms refilling their supplies only by small-lot buying. The prices of metals, such as zinc, have altered greatly, the prices of chemical products remaining, on the contrary, rather steady; prices of alkalis, caustic soda and carbonate of soda, have recently dropped, however. This lowering of prices is the second one this year, the first occurring in January; present prices, therefore, are 5 per cent lower than in 1930.

The leading manufacturer of these products is the Solvay Co. and the prices quoted by this firm are always adopted on the home market. This firm owns two factories in this country, one at Dombasles, in the east of France, and the other at Salins-de-Giraud, in the south of France. Since the return of the annexed part of Lorraine, the outputs of the caustic soda factories of Dieuze (belonging to the Kuhlmann group) of Saaralbe and Chateau-Salins (belonging to the Solvay group) increased the French carbonate soda output by 140,000 tons, making a total yearly output of 500,000 tons. About 25 per cent of this quantity is exported; about 127,000 tons of calcined soda in 1930, not including 73,500 cwt. of bicarbonate of soda.

Caustic potash, which is far from being as important as caustic soda, is manufactured by the Thann works (Haut-Rhin, eastern France), in the neighborhood of the potash mines of Alsace. It is manufactured by the electrolyzing of purified chlorate as supplied by the mines. A new firm has just been floated by the Kali Sainte Therèse Co. and the Thann chemical works. The latter has given the new firm the right to use its electrolytic plant and processes for the manufacture of potash carbonate.

OTHER potash manufacturers are sugar refineries (which extract it by the treatment of molasses) and wool-washing factories. Potash may also be extracted from ashes of seaweeds and the mother-waters of salt lakes, but the potash thus produced is not of first quality. In 1930, caustic potash exports reached 53,030 tons, an increase of 20 per cent over the 1929 exports; but potash carbonate exports have dropped during the same period (6,300 tons in 1929, against 4,000 tons in 1930).

The total exports of chemical products in France reached three billion francs in 1930, showing a decrease of 150 million francs on the total 1929 exports. Pharmaceutical products and perfumery, cosmetics and soaps exports have decreased 15 per cent and 10 per cent, respectively, while rayon exports have increased 30 per cent, synthetic coloring matter exports, 10 per cent, and explosive exports have nearly doubled; several other chemical products also have gained in export trade. Among the latter is bromine, of which about 9,000 cwt. has been extracted from the potash mines of Alsace. The addition of this quantity to the salt lakes' output makes a total of about 11,300 cwt. The home needs do not exceed 4,000 cwt. Bichromate exports have reached 5,220 cwt. and permanganate of potash exports have reached 2,900 cwt. Taking these figures into consideration it should be remembered that none of the aforesaid products were manufactured in France in prewar days and that all home needs were supplied by foreign imports. In 1931 exports of arsenious acid are 10 per cent higher than the 1929 exports, whereas arseniate of soda exports and alum exports have doubled. Barium compound exports have notably increased, sulphate of barium especially (44,000 cwt. in 1929 and 194,000 cwt. in 1930). The following exports have dropped considerably: chloride of lime, perchlorates, hydrogen peroxide, mixed cyanide of potassium, and sodium (the last-named product has dropped from 22,000 cwt. exported in 1929 to 10,800 cwt. exported in 1930). Aluminum anhydrate exports have fallen from about 700,000 cwt. in 1929 to 500,000 cwt. in 1930. Antimony compounds also have dropped considerably, as have exports of magnesium chlorides and sulphate of soda.

BECAUSE of the present world crisis, manufacturers of fertilizers and superphosphates especially are now in difficulties. The decline in the fertilizer industry has been very sudden. In 1930 natural phosphates were extracted on a larger scale than in 1929, which was a record-breaking year. Exports ceased suddenly in September, 1930, as may be gathered by the following figures quoted by the Cherifian Office of Morocco at Casablanca. In 1928 the Moroccan phosphate output was 1,337,000 tons, against 1,779,000 tons in 1930 (1,040,000 tons being exported in the first six months and only 739,000 tons during the rest of the year), a net drop of 30 per cent. As large quantities of manufactured fertilizers were not sold during the autumn or spring, the fertilizer industry is overstocked with manufactured goods and raw material. The normal yearly European consumption of superphosphates is 10,000,000 tons; in 1930 the consumption of phosphates reached only about 6,500,000 tons, a decrease of 3,500,000 tons. France and the French colonies, which usually supply 5,000,000 tons, will, according to present statistics, supply a little under 4,500,000 tons this year.

Large quantities of phosphate fertilizers are exported by France; in 1930 superphosphate exports reached 200,000 tons, against 221,000 tons in 1929. Exports of basic slag increased from 956,000 tons in 1929 to 990,000 tons in 1930, 630,000 tons being imported by Germany. This output is mainly due to the Lorraine steel works and the Sarre territory works, the latter being, according to the treaty of Versailles, under French control as an indemnity for the destruction of the mines of northern France.

Several attempts have been made to regulate the European superphosphate output, leaving to every producer a distinctive sales market and suppressing all dumping and cutting of remunerative prices. This agreement would be based, so to speak, on the same principles as the temporary agreement drawn between the manufacturers of nitrogen fertilizers in order to reduce the surplus output of these fertilizers.

Technically the present tendency is to use high-grade phosphates for the manufacture of superphosphates, but this tendency may be only temporary. The use of high-grade phosphates is followed with keen attention, as the freight and carriage expenses of low-grade phosphates notably increase the sales prices of superphosphates manufactured from them. So far, no definite method has been adopted. It should be noted, however, that a strong press campaign is being made against the use of mineral fertilizers, especially superphosphates and sulphate of ammonia, which, according to the competent opinion of agronomists, decalcifies the soil and in time would ruin it.

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Fertilizer Industry Trade Code

SEVERAL changes in wording made by the Federal Trade Commission in the trade practice conference rules of the fertilizer industry have been accepted by the industry. The Commission placed in Group I three rules relating to practices held to be violations of the law: namely, selling goods below cost with the intent of injuring a competitor; defamation of competitors; and secret payments of rebates. A resolution on false invoicing was accepted by the Commission as an expression of the trade and was placed in Group II.

These rules were originally adopted by the industry at a trade practice conference held under auspices of the Commission in Washington, Jan. 29, 1929, which was attended by representatives of the following branches of the industry; producers of raw materials, importers, and manufacturers.

German Economic Crisis Involves Chemical Industry

Resistant Materials Receive Attention Of Technical Efforts

From Our Berlin Correspondent

MANY HOPES that were engendered by the announcement of the debt armistice have already been destroyed by the delay and political influences or at least postponed to such a time that the critical condition will have to find some additional remedy. The chemical market has reflected this stormy atmosphere in a profound slump, retarding all industrial enterprise. The great rise in the discount rate is leading to a liquidation of the very considerable stock on hand, and this is expected to bring a decline in prices.

The prospects of the coal hydrogenation industry have become even less promising through the low oil and tar prices caused by overproduction in petroleum. The heavy paraffine oils from Hannover must now be counted as competition on the side of the foreign oil. As a result the tar from lignite has slumped below the price in 1913. Even counting on the most favorable possibilities, the petroleum discovery in Thüringen and the refining operations in Hannover are not favorable to the future of lignite hydrogenation.

THE market situation of the German alcohol monopoly also is becoming steadily worse. Already the stocks of this federal agency are exceeding the prospective demands of the coming year, so that theoretically the alcohol industry need not operate at all during the year 1931-32. The only hope is still seen in the obligatory mixture of alcohol with other motor fuels, but here too the prospects have become more discouraging through the general economic crisis; for emergency measures have brought an additional tax of 27 pf. per gal. of motor fuel, giving a total of 76 pf. (19c.) per gal. It is true that the cost distribution has become more favorable for the alcohol constituent, because this is not subject to the mineral oil tax.

A significant merger of interests in the field of electrofiltration was the agreement of Siemens-Schukertwerke A.G. and the Metallgesellschaft, Frankfurt. These two firms have both been active in the electro-precipitation of industrial waste gases and have exchanged patents for a number of years. A holding company has been formed under the name of Siemans-Lurgi-Cottrell-Elektrofilter, G.m.b.H., Berlin, which will administer and exploit not only the processes for the two companies mentioned but also in foreign countries through the newly formed connections.

A new step in the progress of gasoline synthesis is reported by Franz Fischer and Carl Meyer, who have used nickel catalysts which have never before been successful. The nickel is precipitated as carbonate in the presence of an activator such as thorium or manganese and kieselguhr by means of potassium carbonate. Before use these nickel catalysts are reduced with hydrogen at 450 deg. C. The best yield so far obtained with this catalyst in one passage of carbon monoxide and hydrogen gave 120 c.c. of fluid hydrocarbons. On the basis of the carbon monoxide used, 25 per cent of the gas was transformed into fluid and 35 per cent into gaseous hydrocarbons. The life of the nickel catalyst is also very long; after five weeks of uninterrupted operation only a 17 per cent decrease in yield was noted.

A NEW process of F. J. Collin A.G., Dortmund, which has been operated at Hattingen, has achieved great advantages in the dry quenching of coke. The glowing coke is removed to a cooling chamber by means of a truck and the chamber sealed. Then stack gases are led through the chamber and subsequently into the boilers. The effect on the coke is no more deleterious than in the case of wet cooling. But the advantages of dry cooled coke are even more apparent in the grain and firmness of the product, which are far superior to wet quenched coke.

Gas and water piping made from asbestos cement is finding increasing application because of its proof against leak. It is made by mixture of finely divided asbestos with cement in proportions of one to five, and in an excess of water. This mixture is partially dried on a belt and the remaining mass rolled on a drum. Here it is pressed and then transferred, still soft, to a wooden drum in a humid atmosphere, where it sets.

The desirable properties of beryllium, which has received so much recent publicity, have been exploited by the Siemens Co. in the manufacture of springs which retain their elasticity even in red heat. According to W. Kroll, ferrous alloys containing 1 per cent beryllium, 12 per cent chromium and more than 8 per cent nickel are used. Compared with the best tungsten special steels with high creep limit, these beryllium steels have a temperature advantage of 50 to 100 deg. C.

A high-temperature refractory alloy has been developed by the Heräus Vakuumschmelze, Hanau, under the name Chroman, which has proved especially advantageous in enameling furnaces. The operating life of this alloy in grates is said to be 200 times as long as the iron normally used. In addition, Chroman has the advantage of being 30 to 50 per cent lighter than an equivalent grate of iron. This would naturally entail a corresponding economy in fuel.

Heat-resisting surfaces of iron sheets and castings are produced by diffusing aluminum on them in the form of a spray at 800 deg. C. After coating and alloying with the iron, an oxide surface forms which is resistant to heat and atmosphere, as long as mechanical abrasion does not wear through the surface. Copper, brass and nickel also can be treated by this process.

PARKERIZATION, which has already been mentioned in this letter, consists of coating the surface of iron with phosphate. This treatment is now applied for corrosion resistance for more extended application where surfaces are normally painted, nickeled, galvanized, or greased. The process has been effectively applied even to such quantity materials as nails, screws, and the like.

On the other hand, a new oil paint, "Nust," also affords corrosion resistance on the surface of iron and steel. This is achieved by the formation of a lead-iron alloy after only a single application of the paint. It can be used also as a priming coat for further special paints. The coating is not injured by changes of shapes in the object to which it is applied.

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Oil Industry Accepts Revised Code

THE trade practice conference rules for the petroleum industry, as revised by the Federal Trade Commission have been accepted by the oil industry.

On reconsidering these rules, the Commission rescinded former rules 4 and 7, Group I, as published July 25, 1929, but substituted for them the rules now numbered 3 and 6, Group I. The Commission amended former Rule 2, Group I, covering leasing of filling stations, and transferred it to Group II as Rule A.

The remaining Group I rules, as published July 25, 1929, were reaffirmed by the Commission. They pertain to the following practices: Loaning or leasing gasoline pumps, painting over signs of another company as related to breach of contract, inducing breach of contract, substitution of grades of refined products, lotteries, and selling goods below cost with the intent of injuring a competitor.

Group II rules, as previously published, were reaffirmed and accepted as expressions of the trade following amendment of former Rule 17 regarding posted prices. The latter rule, as amended, is now Rule K.

Group II rules cover, among others, such subjects as leasing filling stations, leasing storage equipment to airports, installation costs, construction of driveways, greasing pits and other gas station equipment for retailers, and loaning advertising devices to tank-car buyers.

MEN
IN CHEMICAL ENGINEERING

JOHN F. THOMPSON, assistant to the president of the International Nickel Co. of Canada, Ltd., has been appointed vice-president. He already was vice-president of the American subsidiary, the International Nickel Co.

J. C. NICHOLLS, who was general manager of the International Nickel Co. of Canada, Ltd., has been promoted to assistant to the president at Toronto.

DONALD MACASKILL has been promoted from manager of the mining and smelting division to general manager of the operations of International Nickel Co. of Canada, Ltd., at Copper Cliff, Ont.

KENNETH M. WATSON, formerly professor of chemical engineering at the University of Wisconsin, Madison, has joined the research and development staff of Universal Oil Products Co., with headquarters in Chicago.

CHARLES L. PARSONS, business manager of the American Chemical Society and for 21 years professor of chemistry in New Hampshire College, was elected to honorary membership in the Society of Chemical Industry at its meeting in London.

WILLIAM U. GALLAHER has joined the purification department of the Community Water Service Co., Harrisburg, Pa., after extensive work at water purification plants in Illinois and at the General Chemical Co.

PAUL BURKE JACOBS, chemical engineer of the Bureau of Chemistry and Soils, has been appointed to direct the plant-scale experiments on farm by-products to be inaugurated this month at Ames, Iowa, at the State College in cooperation with the U. S. Department of Agriculture. Working with Mr. Jacobs will be O. R. Sweeney and Max Levine, of Iowa State College; and A. M. Buswell, of the University of Illinois.

JOHN WILLIAM FORDHAM JOHNSON, president and managing director of the B. C. Sugar Refining Co., Ltd., Vancouver, has been appointed Lieutenant Governor of the Province of British Columbia.

C. C. SMOOT, past president of the American Leather Chemists' Association and extensively active in industrial work on leather, has been appointed technologist on tanning and tanning materials by the Bureau of Chemistry and Soils, U. S. Department of Agriculture. His work will be devoted to development of sources of tanning materials and processes.

EDWARD J. MEHREN has resigned as vice-president of the McGraw-Hill Publishing Co., Inc., to assume the post of active president of the Portland Cement Association early in September. Contrary to precedent, the position will now require full-time application and is being filled for the first time by a personality outside of the cement industry. Mr. Mehren's career in engineering and publishing has especially fitted him for

this work. A graduate from the University of Illinois in 1906, he became associate editor of the *Engineering Record* in 1907 and remained with it almost uninterruptedly until 1923. Meanwhile it had merged with *Engineering News* to become the *Engineering News-Record*, of which he was editor for five years. He became a vice-president of the McGraw-Hill Publishing Co. in 1918 and editorial director of the company in 1923. When the A. W. Shaw Co. was absorbed in 1929, he went to Chicago as resident vice-president.

J. C. HUTCHINSON has been appointed general manager of the Northwest Magnesite Co., Chewelah, Wash.

P. A. LASSELLE, for 4 years in the chemical department of the Bell Telephone Laboratories, has resigned to enter Pennsylvania State College in September for advanced study. His work has centered around varnishes and insulating materials.

C. W. BORGMANN, chemical engineer at the Bell Telephone Laboratories for 6 years, specializing in corrosion, is leaving on Sept. 11 to study at Cambridge University under the authority on corrosion, Ulick R. Evans.

OBITUARY

CLINTON PAUL TOWNSEND, distinguished electrochemist and patent attorney, died after a long illness at his home, Great Neck, Long Island, on Aug. 4 at the age of 63. Following graduation from Columbian College, now George Washington University, Mr. Townsend served in the U. S. Patent Office in the then new division of electrochemistry for six years. Subsequently he did research in his chosen field and as one of the results of his work invented the widely known Townsend cell. In 1903 he formed the patent firm of Byrnes & Townsend which became Byrnes, Townsend & Brickenstein and quite recently Byrnes, Townsend & Potter. He was associated with L. H. Baekeland in the early development of Bakelite and for many years had also been engaged in the research activities of Hooker Electrochemical Co. He was director of the Research Corporation and for many years a director of research activities and the chief patent counsel of Union Carbide & Carbon Corp. Practically all of his life up to 1921, Mr. Townsend made his home in Washington, D. C.; but since that date he had lived at Great Neck and maintained offices in New York City.

SAMUEL J. FOWLER, until his retirement in 1922 a chemist active in many industrial fields, died on Aug. 3 at his home in Cambridge, Mass., 80 years old. Born in Westfield, Mass., he studied in Germany and Belgium, later returning to apply his efforts in such diverse industries as textiles, nitrocellulose, and gas.

CALENDAR OF FORTHCOMING EVENTS

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, fall meeting, Atlantic City, N. J., Dec. 9-11.

AMERICAN CHEMICAL SOCIETY, 82d meeting, Buffalo, N. Y., Aug. 31-Sept. 4.

AMERICAN GAS ASSOCIATION, annual meeting, Atlantic City, Oct. 12-16.

ELECTROCHEMICAL SOCIETY, fall meeting, Salt Lake City, Utah, Sept. 2-5.

MATERIALS HANDLING EXPOSITION, first meeting, New York City, Nov. 30-Dec. 5.

NATIONAL SAFETY COUNCIL, annual meeting, Chicago, Oct. 12-16.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Kalamazoo, Mich., Sept. 24-26.

THIRD INTERNATIONAL CONFERENCE ON BITUMINOUS COAL, Pittsburgh, Nov. 16-21.

MARKET APPRAISAL OF CHEMICAL INDUSTRY

ANNUAL report of Procter & Gamble Co. for year ended June 30 shows net profit of $22,650,818 after depreciation, interest, federal taxes, etc., equivalent after preferred dividends to $3.37 a share on 6,410,000 no-par common shares. This compares with net profit, including credit adjustment of prior year's tax reserves amounting to $240,282, of $22,450,600, or $3.37 a common share.

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Stockholders of Westvaco Chlorine Products, Inc., have been offered 59,807 shares of no-par stock at $17.50 a share in the ratio of 17 new shares for every 64 shares held. The additional issue is to reimburse the company for expenditures of approximately $2,300,000 made in the last two years.

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Congoleum-Nairn, Inc., has resumed dividend payments on its common stock by voting a disbursement of 25c. a share payable Sept. 15. Dividends had not been paid since 1925, in which year $2.50 a share was paid.

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Vacuum Oil Co. has requested stockholders to turn in their certificates of stock in exchange for new certificates of the Socony-Vacuum Corp., on the basis of 2½ shares of the latter for one of Vacuum. In lieu of fractional shares of Socony-Vacuum, stockholders will receive cash at the rate of $18.25 a share. The exchange is pursuant to approval of the merger with Standard Oil Co. of New York. The properties have been transferred and Vacuum Oil Co. will be dissolved.

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Eagle-Picher Lead Co. reports for six months ended June 30, 1931, net loss of $316,002 after depreciation, depletion, inventory adjustments, etc., comparing with net loss of $836,412 in first half of 1930.

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The Sherwin-Williams Co., Cleveland, has declared the usual extra dividend of 12½c. per share on the common stock, together with the regular quarterly distribution of $1 per share. The regular quarterly dividend of $1.50 per share also was declared on the preferred AA stock. George A. Martin, president, stated that the June earnings were approximately $160,000 above the same month last year.

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Financial statements issued by companies in chemical producing and consuming industries show net profits as follows for the first half of the year:

	First Half 1931	First Half 1930
Abbott Laboratories	$261,262	$265,718
Air Reduction	2,045,491	2,883,845
American Commercial Alcohol	42,941*	175,931
Am. Solvents & Chemical	497,953*	.....
Atlas Powder	409,120	725,023
Beech-Nut Packing	1,329,338	1,438,814
Bon Ami	650,943	700,467
Commercial Solvents	1,182,343	1,497,517
Congoleum-Nairn	607,842	705,857
Consolidated Chemical	238,544	313,341
Corn Products	5,494,267	6,641,261
Du Pont	27,610,394	32,951,314
Freeport Texas Sulphur	1,185,092	1,678,561
General Printing Ink	362,462	413,161
Hercules Powder	736,103	1,598,468
International Salt	399,320	366,951
Lehn & Fink	777,300	918,383
Lambert Company	3,572,529	3,764,349
Mathieson Alkali	675,549	1,107,633
Monsanto Chemical	671,450	622,397
Nat'l Distillers Products	381,137	243,921
Texas Gulf Sulphur	4,388,165	7,452,046
Union Carbide	9,119,825	12,779,585
United Piece Dye	936,374	1,911,164
U. S. Industrial Alcohol	527,287*	552,485
Westvaco Chlorine	376,682	450,754

* Net loss.

Price Range Jan.-July High	Low	Stock	Price Range in July — July 1	High	Low	July 31
19¼	5	Agfa Ansco Corp	....	7¼	6¼	....
109¾	70¾	Air Reduction	86	89	73¾	74
182¾	102¼	Allied Chemical	129¼	133	105¾	106½
224	90	Aluminum Co. of America	137	146½	108¼	110
29½	11½	Am. Ag. Chemical, Del.	....	18	13	13¾
14½	5¼	Am. Commercial Alcohol	8¼	9½	6¼	6½
12¼	6¼	American Cyanamid, B	8¼	8¼	7⅛	7¼
8	1¼	American Hide & Leather	....	7¼	6	....
23½	8½	American Metal	13¼	15¼	9¼	10½
4½	1	American Solvents & Chemical	....	2	1	1½
18	8	Archer-Daniels-Midland	10½	11½	9½	....
4½	1½	Armour, Ill., A	2¼	2½	1¼	2
23¾	11½	Atlantic Refining	16	17	14¼	14¼
54	30	Atlas Powder	38	38	36½	....
62	44½	Beech-Nut Packing	....	52½	50	....
1¼	⅛	British Celanese	....	1¼	1¼	....
25	12	California Petroleum	....	12	12	....
7½	2½	Certain-teed Products	6	6½	5	5¼
12¼	10	Chickasha Cotton Oil	10	10½	10	....
50½	40	Colgate-Palmolive-Peet	45	46½	44	44¾
111¼	55	Columbian Carbon	80¼	84	66¼	66¼
21½	10¾	Commercial Solvents	14¼	17¾	14	16¼
86¼	55¼	Corn Products Refining	75	76½	63	64¼
23	9¼	Davison Chemical	13	14	10¼	11
19¼	11	Devoe & Raynolds, A	14¼	15	13¾	....
51	34	Dow Chemical	....	45	42¾	....
107	71	Du Pont	90¼	92¾	83¼	87
124	118¾	Du Pont, 6 pc. deb	123	123¾	122¾	....
3½	1¼	Duval Texas Sulphur	....	1¼	1¼	....
185¾	118	Eastman Kodak	150½	154	133½	135¼
21½	13	Firestone Tire	19	22	18	....
⅜	⅛	Fisk Rubber	⅛	⅛	⅛	⅛
43¼	22	Freeport Texas Sulphur	28½	29¼	25½	26
47	15½	General Asphalt	24¼	26½	18½	19½
16½	7¼	Glidden Co	10½	10¼	8¼	9¼
42¼	21	Gold Dust	30½	32	26½	27
20⅜	8¼	Goodrich Co	13¼	15¼	11¼	12½
58	40	Hercules Powder	....	46	45	....
13	9	Heyden Chemical	....	....	....	....
4¼	2¼	Imperial Chemical, Ltd	....	....	....	....
86	21½	Industrial Rayon	34	36½	28	28
5½	1¼	Int. Ag. Chemical	....	2½	1¼	....
20½	9½	International Nickel	15¾	16½	12½	12½
10½	4	International Paper, A	....	6	4½	....
42	29½	International Salt	35	36	32½	33½
16½	10	Kellogg, Spencer & Sons	....	15	15	....
3½	1¼	Kelly-Springfield	2¼	2½	2	2¼
4½	2½	Lee Rubber & Tire	....	3¼	3½	3¼
34½	22½	Lehn & Fink	26	27½	25½	25½
20¼	11½	Libbey-Owens	18½	20	14½	15
55½	20½	Liquid Carbonic	31½	34	27½	27½
17	7½	McKesson & Robbins	10¾	11½	8¼	9½
31½	17¾	Mathieson Alkali	22½	23¼	20½	22
28	18½	Monsanto Chemical	23¼	28	23	....
36¼	19¾	National Distillers Products	28¼	29½	24½	25
132	85	National Lead	120	122	104	....
51	35	New Jersey Zinc	41	43	39	....
20¾	10½	Newport Co	....	19¼	15¼	....
19½	7	Ohio Oil	11	11¼	8¾	9¼
39¾	25½	Owens-Ill Glass	32½	33	30¼	....
16¼	4¾	Phillips Petroleum	8¼	9	7	7½
42½	29¼	Pittsburgh Plate Glass	....	35	35	....
40½	33	Pratt & Lambert	34	40	34	....
71½	56	Procter & Gamble	65	65	62	64
11¼	5½	Pure Oil	8	8½	6¼	7¼
66½	52	Sherwin-Williams	....	61	60½	....
12	3¾	Silica-Gel	5½	5½	4	....
15½	6¼	Sinclair Oil	10¼	11¼	8¼	10¼
12¾	3½	Skelly Oil	....	6	4¼	....
51½	31½	Standard Oil, Cal	37½	39½	35½	36½
52½	30½	Standard Oil, N. J	39	40¼	35½	37½
26	13¾	Standard Oil, N. Y	17¾	18¼	15¼	17¼
45½	31	Sun Oil	....	42	35½	....
3½	2¼	Swan & Finch	....	3½	2¼	....
30¼	24½	Swift & Co	....	26¼	25¼	26
9½	5¼	Tennessee Corporation	6¼	7¼	6	....
36½	18	Texas Corporation	24	24½	21½	23¼
55½	29¼	Texas Gulf Sulphur	37¼	39½	32½	33¼
9	4	Tidewater Assoc. Oil	6	6¼	4¼	5¼
16	3¼	Tubize-Chatillon, B	6¼	6¼	5	....
72	43½	Union Carbide	53½	55½	47¼	48¼
26¾	14	Union Oil, Cal	18¼	19	15¼	....
28¾	13	United Carbon	16½	18¼	14¼	15½
77¾	24¼	U. S. Industrial Alcohol	32¼	33½	27¼	27¼
10¾	3¼	U. S. Leather	7	8¼	6¼	6¼
20¾	10½	U. S. Rubber	16½	17	12¼	13¼
69¾	22¼	Vacuum Oil	42¼	47	39¼	45
76¾	23½	Vanadium Corp	35¼	38½	25¼	26¼
3¼	1	Va-Car. Chemical	....	1¼	1¼	....
26½	17¾	Wesson Oil	22	22	19	19½
40	18	Westvaco Chlorine	26¼	27¼	19	19
3¼	1½	Wilson & Co	....	2	2	....

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Consumption of Chemicals Lower In Six-Month Period

Lessened Demand Found at Home And for Export

ACCORDING to the adjusted indexes of the Department of Commerce, industrial production for the first half of this year fell 16.3 per cent below that of the corresponding period of last year. Because of its various ramifications, it is difficult to make a similar comparison for the chemical industry as a whole. For instance, fertilizer chemicals have suffered as a result of conditions found in the fertilizer industry, and the movement of these chemicals undoubtedly has been below that of general industry. On the other hand, some of the chemicals which enter into the manufacture of insecticides have outstripped the records of last year.

Statistics for June referring to production of some chemicals and indicating activities in some consuming lines follow:

	June 1931	June, 1930
Production		
Acetate of lime, 1,000 lb.	1,853	4,847
Methanol, crude, gal.	182,273	319,478
Methanol, refined, gal.	94,765	418,205
Methanol, synthetic, gal.	654,472	561,646
Arsenic, crude, ton	1,407	2,168
Arsenic, refined, ton	1,024	1,081
Byproduct coke, 1,000 tons	2,715	3,954
Turpentine, wood, bbl.	5,675	6,774
Rosin, wood, bbl.	34,747	40,049
Pine oil, gal.	231,207	248,777
Sulphuric acid, made by fertilizer industry, ton	84,051	164,553
Automobiles, cars, no.	207,798	285,473
Trucks, no.	41,304	48,570
Taxis, no.	360	463
Plate glass, 1,000 sq.ft.	7,554	9,466
Consumption		
Cotton, bales	455,388	405,236
Silk, bales	42,161	29,396
Wool, 1,000 lb.	45,505	32,772
Sulphuric acid in fertilizers, ton	90,804	190,202

A general review of the consuming outlets for chemicals shows definitely that raw materials were required in smaller volume so far this year than was the case in 1930. The rate of decline is not uniform and the textile industry runs counter to the general rule with an increase in takings of materials. Production of rayon in the first half of the year is estimated at 56,000,000 lb., and, as production is now going on an enlarged scale, the prospects are favorable for equaling if not surpassing the output of 1930.

Consumption of crude rubber by manufacturers in the United States for the month of June is estimated at 37,916 long tons, showing practically no change as compared with May, which is counter to the usual seasonal decrease of 5 per cent experienced in previous years.

SALES of paints, varnishes, and lacquers are reported in values and, as unit prices are lower this year, it is evident that loss in value is not a true indication of loss in quantity. For the first five months of this year, such sales were reported at $133,716,451, as compared with $163,348,650 for the like period of 1930. Sales of plastic, cold water paints, and calcimines for the first half of this year amounted to 32,259,063 lb., compared with 35,028,401 lb. for the first half of last year.

Production of vegetable oils so far this year has fallen below the level maintained a year ago. The loss is mainly due to reduced crushings of cottonseed and linseed. It is noted that soya-bean oil production is increasing rapidly, and this promises to become an important branch of the domestic industry. Sesame and sunflower oils also are being produced in a larger way this year in this country.

The Department of Commerce reports that foreign trade in chemicals and allied products continued the downward trend evident the past year, with exports of $68,368,000 for the first six months of 1931, nearly $3,000,000 greater than imports during the same period. This is the first time that the balance of chemical trade was in favor of the United States, although twice before in recent years exports and imports have about balanced. A few commodities showed increases both in exports and imports, but for the most part the declines were general throughout.

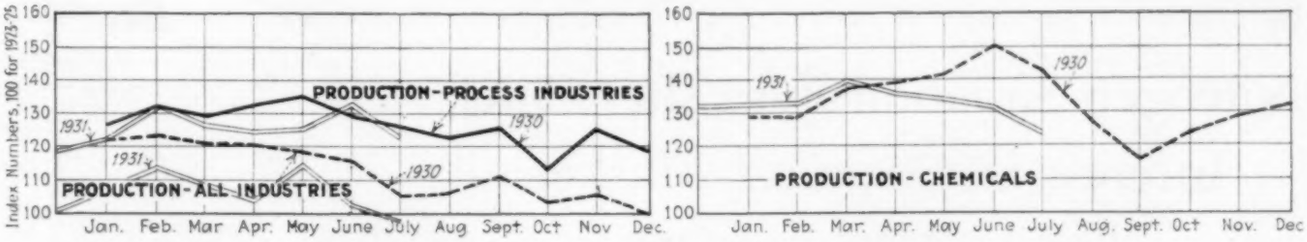
NAVAL STORES and sulphur frequently indicate the trend in the chemical export trade, and both these items recorded sharp decreases. Chemical manufactures, industrial specialties, medicinals, pharmaceuticals, and toilet preparations have kept up comparatively well. Imports of practically all crude materials were considerably below last year's figures, with the exception of pyrites, which made a 40 per cent advance. Imports of coal-tar dyes held their own with little change in value and only an 8 per cent loss in quantity.

The considerably lower prices during the current six months compared with the corresponding period of 1930 contributed to the 57 per cent decrease in value of naval stores exported. Quantity shipments of rosin, 442,500 bbl., were 27 per cent less, and of gum spirits of turpentine, 3,712,000 gal., 33 per cent less than in the first half of 1930, but shipments of wood turpentine, amounting to 433,000 gal. were 7 per cent greater.

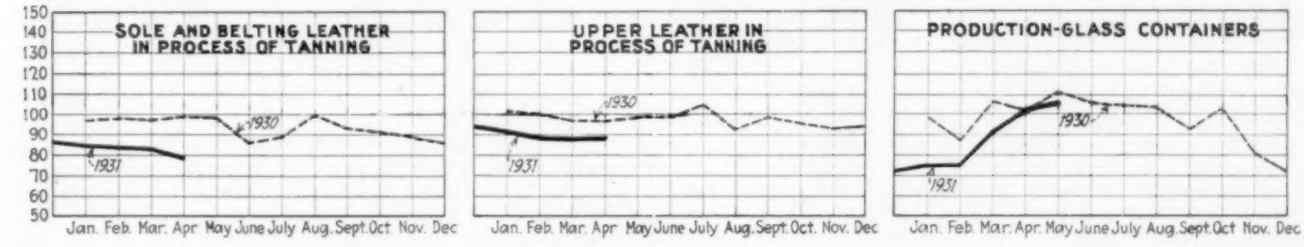
Factory Production and Consumption of Vegetable Oils

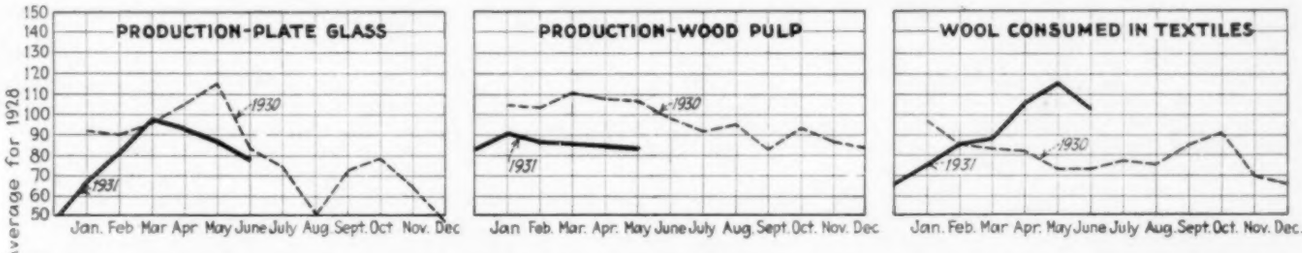
	Production		Consumption	
	First Half 1931 Lb.	First Half 1930 Lb.	First Half 1931 Lb.	First Half 1930 Lb.
Cottonseed, crude	490,621,438	653,569,868	600,693,158	737,112,571
Cottonseed, refined	541,574,877	662,309,306	519,096,853	587,339,904
Peanut, crude	9,275,592	18,525,180	7,750,231	7,641,932
Peanut, refined	6,661,757	5,357,912	6,616,264	4,648,071
Coconut, crude	173,344,686	169,280,867	277,382,954	327,208,160
Coconut, refined	133,618,878	142,032,800	153,827,658	147,921,227
Corn, crude	57,630,495	55,960,770	60,762,712	63,363,847
Corn, refined	51,991,870	47,865,301	12,532,616	8,451,419
Soya bean, crude	20,082,244	6,139,943	15,956,583	9,223,631
Soya bean, refined	9,924,567	2,443,685	7,633,412	4,723,863
Olive, edible	1,509,164	808,995	693,468	1,025,748
Olive, inedible	5,250	.....	3,842,556	3,619,157
Sulphur oil	.....	.....	20,764,226	20,070,439
Palm kernel, crude	7,129,018	379,403	29,857,090	26,869,587
Palm kernel, refined	12,285,505	7,682,471	12,213,937	8,050,004
Rapeseed	.....	.....	4,551,304	5,843,516
Linseed	249,051,887	276,833,207	169,636,174	199,877,455
China wood	.....	.....	47,284,527	50,586,428
Castor	25,945,074	26,772,374	9,102,108	10,267,710
Palm	.....	.....	137,450,002	104,596,145
All other	774,340	6,703,396	29,600,479	12,513,811
Totals	1,791,426,642	2,082,663,478	2,127,248,312	2,340,962,625

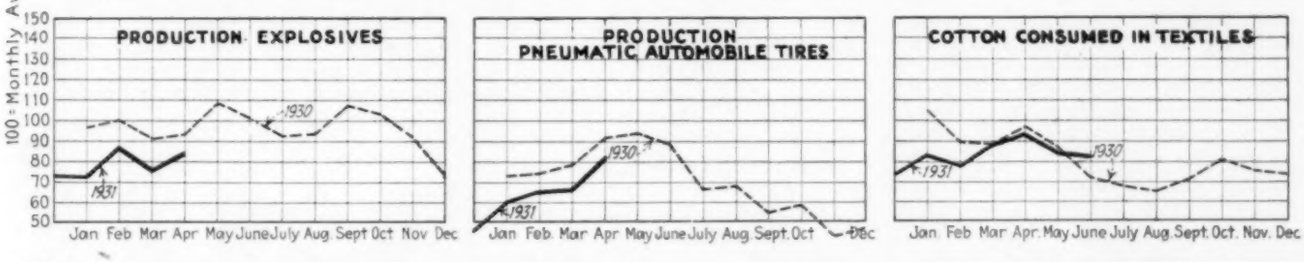
ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES

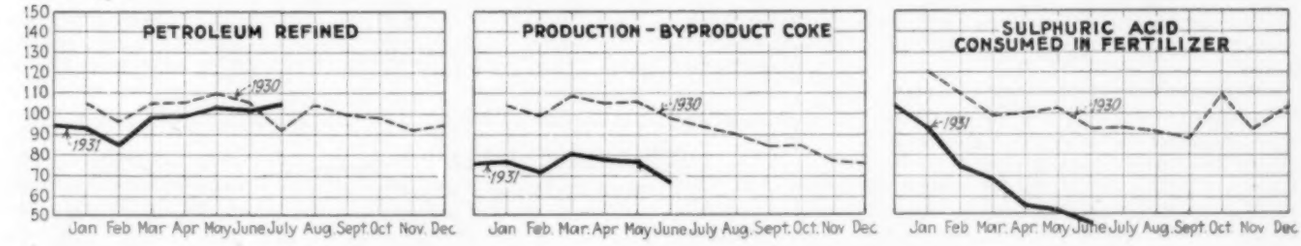


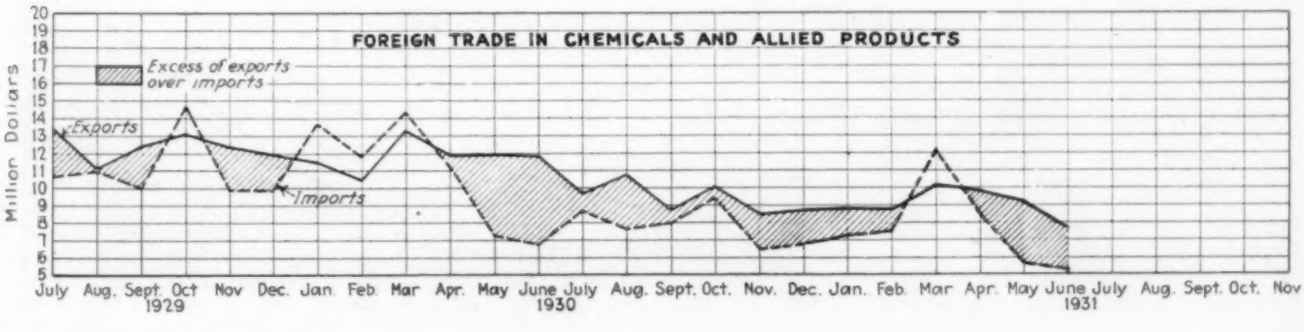
Based on electrical power consumption, data supplied by Electrical World


SOLE AND BELTING LEATHER IN PROCESS OF TANNING
UPPER LEATHER IN PROCESS OF TANNING
PRODUCTION-GLASS CONTAINERS
1931
1930
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec


100 = Monthly Average for 1928
PRODUCTION-PLATE GLASS
PRODUCTION-WOOD PULP
WOOL CONSUMED IN TEXTILES
1931
1930
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


PRODUCTION EXPLOSIVES
PRODUCTION PNEUMATIC AUTOMOBILE TIRES
COTTON CONSUMED IN TEXTILES
1931
1930
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


PETROLEUM REFINED
PRODUCTION - BYPRODUCT COKE
SULPHURIC ACID CONSUMED IN FERTILIZER
1931
1930
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Million Dollars
Excess of exports over imports
Exports
Imports
July Aug. Sept. Oct Nov Dec. Jan. Feb Mar Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar Apr. May June July Aug. Sept. Oct. Nov
1929
1930
1931

MARKET CONDITIONS —AND PRICE TRENDS

Nitrogen Situation Furnishes Chief Interest in Chemical Market

Imported Sulphate of Ammonia Held At Southern Ports

BY FAR the most important development in the market for chemicals in the last month was connected with advices from abroad to the effect that attempts to negotiate a renewal of the international nitrogen cartel had met with failure and had been discontinued. Our attaché at Paris cabled that negotiations for an extension of the international nitrogen cartel which have been in progress for the past two months have been terminated without an agreement either as to world control or European distribution. According to well-informed sources this development means that Chile will resume open-market sales as before the first international agreement two years ago.

The break-down of the conference is reported to be due to Chilean demands for a quota increase which were unacceptable to other delegates and because of an announcement by Germany imposing as of July 15, new duties so prohibitive as to constitute in effect an embargo on importation of Chile nitrates, the trade advices indicate. German imports of Chile nitrates during the first five months of the current year totaled 63,000 tons, as compared with 58,000 tons during the corresponding period of 1930, while exports of German synthetic nitrate of soda amounted to 20,000 tons, in comparison with 27,000 tons in the 1930 period.

Following this announcement domestic markets were disturbed by reports that sulphate of ammonia of foreign origin was quoted for shipment to the United States at very marked concessions from the figures previously maintained for both imported and domestic sulphate. It was no secret that large stocks of nitrogen, especially in the form of sulphate of ammonia, were held by some of the European producers. The promptness with which prices were lowered to attract American buyers had a demoralizing effect, but domestic producers began to meet bona-fide offerings from abroad, even though the sales prices were not attractive.

IT IS reported that importers of four shipments of sulphate of ammonia totaling approximately 2,000 tons which entered Jacksonville on the steamer "Magmeric," July 21, have been required to post a bond pending an anti-dumping investigation on the part of the Treasury Department. It is stated that of this material, two shipments amounting to 1,000 long tons originated in Germany, and one shipment of 816 short tons originated in the Netherlands. The origin of a shipment of 224 short tons was not stated.

Whether or not foreign sulphate of ammonia is being offered in this country below the levels maintained in the countries of origin, it is evident that the world nitrogen industry is in a position where keen competitive measures will be adopted unless some way is found to bring about stabilization.

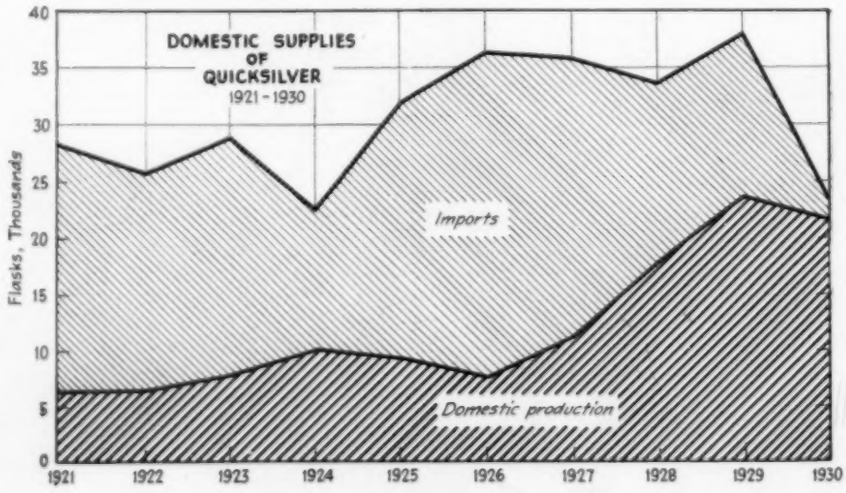
NAVAL stores continued to maintain an erratic course during the period and while the low levels reached resulted in larger quantities of rosin and turpentine changing hands, the weight of stocks is still felt and no progress appears to have been made toward price recoveries. Production is expected to fall off in the near future and smaller receipts from primary points may bring about a firmer market.

The government report on flaxseed conditions during July proved very disappointing. The report stated that flax suffered severely from the drought and hot weather during July, which caused poor filling and forced ripening. The condition of the crop on Aug. 1 was reported at 43.2 per cent of normal, the lowest August condition on record, and the yield per acre is forecast at 4.4 bu. which would be below the previous low record of 4.6 bu. per acre in 1917. The total crop is forecast at 13,807,000 bu. compared with the 21,400,000 bu. harvested last year and the average of 20,900,000 bu. during the previous five years.

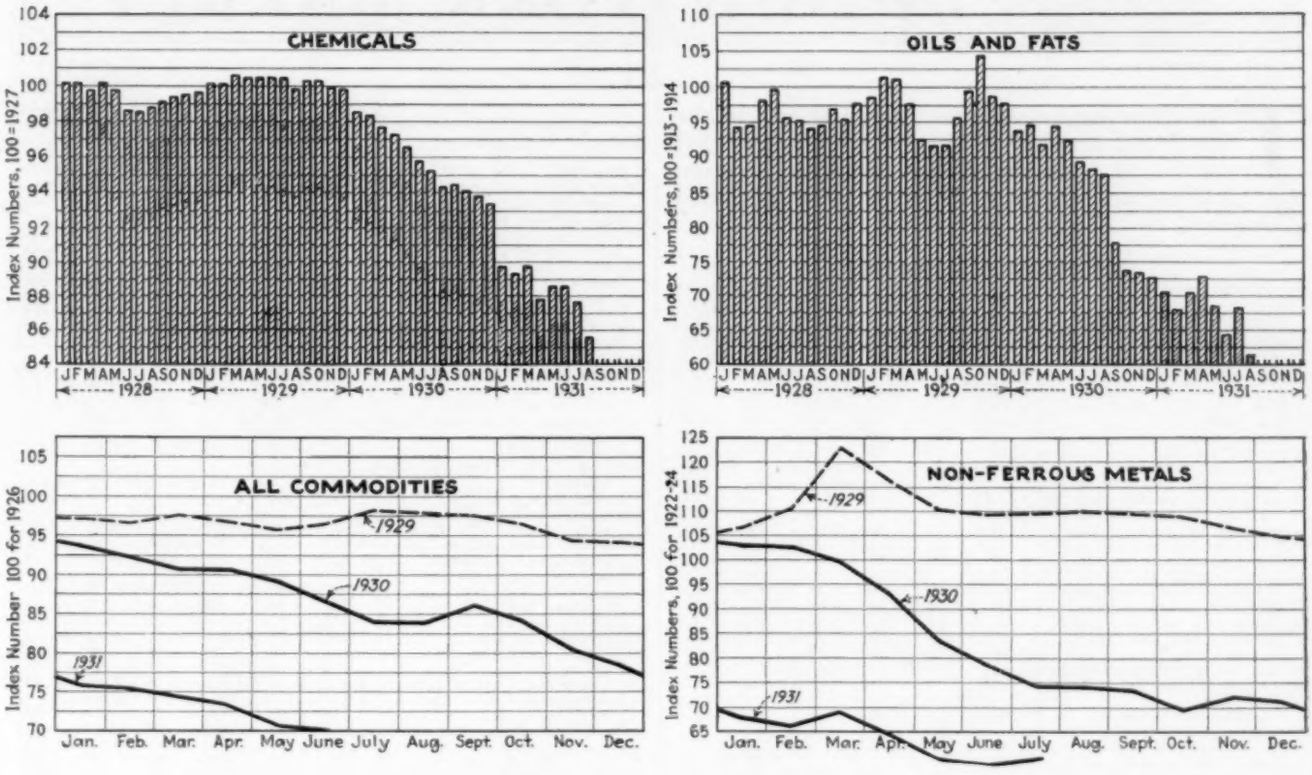
Quicksilver is another product which aroused interest because of its sharp downward price movement. For a long time the market had been well stabilized and values fluctuated within narrow limits. Domestic production increased considerably last year and under the prevailing duty, imported material supplied only a small part of domestic requirements. In fact the foreign combination did not reduce its price and apparently did little to further trade in this country. A short time ago the price was lowered abroad and greater competition was given to domestic producers. As the domestic supply is said to be large at present there also has been competition among sellers of the domestic product and buyers have been able to acquire stocks at attractive prices. The present state of the market, however, indicates that the domestic industry has been established on a firmer basis and will continue to hold a large share of the domestic trade.

United States Supply of Quicksilver

	Domestic Production Flasks	Imports Flasks	Total Supply Flasks
1921	6,339	21,874	28,213
1922	6,375	20,467	26,842
1923	7,937	20,914	28,851
1924	10,085	12,076	22,161
1925	9,174	22,781	31,955
1926	7,622	28,614	36,236
1927	11,276	24,650	35,926
1928	17,870	15,583	33,453
1929	23,682	14,292	37,974
1930	21,553	2,943	24,496



CHEM. & MET. *Weighted Indexes of* PRICES



Ammonium Sulphate Affects Price Index

AS AN aftermath of the breaking up of the international nitrogen cartel, foreign-made sulphate of ammonia has been offered on our market as low as $26 per ton, possibly lower, and attempts of domestic sellers to meet this competition have brought about a sharp break in values which has contributed materially to the downward movement of the weighted index number for the month. With open markets now in prospect for nitrogen products the price movement may continue downward before any stabilizing influence will be brought to bear on the situation. Revisions in nitrate of soda prices are anticipated and the future position of the market is difficult to foresee if competition is unrestrained.

The naval stores industry has suffered further losses in the way of unit values, with turpentine and rosins selling below prewar levels. The statistical position of naval stores is hardly favorable for an immediate price recovery, although low prevailing prices have acted as a stimulant on buying.

Quicksilver also has attracted considerable attention, because of steadily declining market prices.

While price cutting has existed in different branches of the chemical industry, developments along that line during the month were not important and, considering the apathy of buyers and the let-down in general manufacturing activities, chemical values have shown considerable resistance to declines.

Vegetable oils have worked more in unison, with the advantage in favor of buyers. The government estimate of 15,584,000 bales for the growing cotton crop must be construed in a bearish sense from its influence on values for cottonseed oil over the coming year. As the position of cottonseed oil has much to do with establishing prices for other vegetable oils, it would appear that another year of low prices will rule in the market for oils.

While linseed oil has weakened, in common with the other oils, it is more independent of competitive conditions. Judged purely from a demand and supply standpoint, present prices appear to be low. Condition of the flaxseed crop in the American Northwest as of July 1 indicated an outturn of 17,900,000 bu. During July weather conditions were unfavorable and condition as of Aug. 1 indicated a yield of 13,800,000 bu. The outlook, therefore, is for an unusually low domestic seed supply.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**85.77**
Last month	87.51
August, 1930	94.15
August, 1929	99.75

While basic chemicals, as a rule, were holding at unchanged levels, foreign competition brought a sharp drop in values for sulphate of ammonia. Spirits of turpentine were further reduced in price and quotations for several coal-tar chemicals were lowered.

Chem. & Met. Weighted Index of Prices for Oil and Fats

Base = 100 for 1927

This month	**61.53**
Last month	68.05
August, 1930	87.36
August, 1929	95.74

While crude cottonseed oil closed the period in a nominal position, the price level over the month was considerably below that of the preceding month. Linseed oil also was lower and practically throughout the list price weakness was in evidence.

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Aug. 14.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.10 -$0.11	$0.10 -$0.11	$0.11 -$0.12
Acid, acetic, 28%, bbl., cwt.	2.60 - 2.85	2.60 - 2.85	3.11 - 3.25
Glacial 99%, tanks	8.98	8.98	
drs.	9.23 - 9.48	9.23 - 9.48	
U. S. P. reagent, c'bys.	9.73 - 9.98	9.73 - 9.98	
Boric, bbl, lb.	.06½- .07	.06½ .07	.06½ .07
Citric, kegs, lb.	.35 - .36	.36 - .37	.46 - .47
Formic, bbl, lb.	.10 - .11	.10 - .11	.10½- .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb.	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl, lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18°, tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50- 20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb.	.23 - .35	.23 - .35	.35 - .40
Tartaric, powd., bbl., lb.	.30½- .33	.30½- .33	.34½- .36
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.33 -	2.33 -	2.63 - 2.71
Alcohol, Butyl, tanks, lb.	.15½-	15½-	.16½- .17
Alcohol, Amyl			
From Pentane, tanks, lb.	.203-	.203-	.236
Denatured, 188 proof			
No. 1 special dr., gal.	.28 -	.27 -	.39 -
No. 5, 188 proof, dr., gal.	.28 -	.27 -	.39 -
Alum, ammonia, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.05½- .06
Potash, lump, bbl., lb.	.03½- .04	.03½ .04	.03 - .03½
Aluminum sulphate, com., bags, cwt.	1.25 - 1.40	1.25 - 1.40	1.40 - 1.45
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb	.02½- .03	.02½ .03	.03 - .04
tanks, lb.	.02½- .02½	.02½- .02½	-
Ammonia, anhydrous, cyl., lb	.15½- .15½	.15½- .15½	.15½
tanks, lb.	.05½-	.05½-	.05½-
Ammonium carbonate, powd. tech., casks, lb.	.10½- .11	.10½- .11	.10½- .11
Sulphate, wks., cwt	1.75 -	1.75 -	2.00 -
Amylacetate tech., tanks, lb., gal	.172-	.172-	.222-
Antimony Oxide, bbl., lb.	.08 - .09	.08 - .09	.09 - .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs., lb.	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	58.00 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	64.00 -70.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb.	.033-	.033-	.033-
Bromine, cs., lb.	.36 - .38	.36 - .38	.45 - .47
Calcium acetate, bags	2.00 -	2.00 -	3.00 -
Arsenate, dr., lb.	.06 - .07	.06 - .07	.07 - .08
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton	20.00 -	20.00 -	20.00 -
flake, dr., wks., ton	22.75 -	22.75 -	22.75 -
Phosphate, bbl., lb.	.08 - .08½	.08 - .08½	.08 - .08½
Carbon bisulphide, drums, lb.	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06 - .07
Chlorine, liquid, tanks, wks., lb.	.01½-	.01½-	.024
Cylinders	.04 - .06	.04 - .06	.04½- .06
Cobalt oxide, cans, lb.	1.35 - 1.45	1.35 - 1.45	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton	13.00 -14.00	13.00 -14.00	13.00 -14.00
Copper carbonate, bbl., lb.	.08½- .18	.08½- .17	.09 - .18
Cyanide, tech., bbl., lb.	.41 - .46	.41 - .46	.45 - .46
Sulphate, bbl., cwt.	3.60 - 3.75	3.70 - 4.00	4.25 - 4.50
Cream of tartar, bbl., lb.	.22½- .23	.23½- .24	.26 - .27
Diethylene glycol, dr., lb.	.14 - .16	.14 - .16	.11 - .13
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb.	.06 -	.06 -	.103-
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.07½- .08
Furfural, dr., contract, lb.	.10 - .12	.10 - .12	.10 - .12
Fusel oil, crude, drums, gal.	1.10 - 1.20	1.10 - 1.20	1.30 - 1.40
Refined, dr., gal.	1.80 - 1.90	1.80 - 1.90	1.90 - 2.00
Glaubers salt, bags, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra., lb.	.11½- .12	.11½- .12	.13 - .14
Lead:			
White, basic carbonate, dry casks, lb.	.07½-	.07½-	.07½-
White, basic sulphate, sck., lb	.07 -	.07 -	.07½-
Red, dry, sck., lb.	.07½-	.07½-	.09 -
Lead acetate, white crys., bbl., lb	.11 - .12	.11 - .12	.12 - .13
Lead arsenate, powd., bbl., lb.	.10 - .14	.10 - .14	.13 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb.	.06½-	.06½-	.08 -
Lithopone, bags, lb.	.04½- .05	.04½- .05	.05½- .06½
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½
Methanol, 95%, tanks, gal.	.33 -	.33 -	.38 -
97%, tanks, gal.	.34 -	.34 -	.39 -
Synthetic, tanks, gal.	.37½-	.37½-	.40½- .45
Nickel salt, double, bbl., lb.	.10½- .11	.10½- .11	.13 - .13½
Single, bbl., lb.	.10½- .11	.10½- .11	.13 - .13½
Orange mineral, csk., lb	.09½-	.09½-	.11 -
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb.	.31 - .32	.31 - .32	.31 - .32
Potassium bichromate, casks, lb	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½- .06	.05½- .06	.05½- .06
Chlorate, powd., lb.	.08 - .08½	.08 - .08½	.08½- .09
Cyanide, cs., lb.	.55 - .57	.55 - .57	.52 - .55
First sorts, csk., lb.	.08½- .09	.08½- .09	.09½- .09
Hydroxide (caustic potash) dr., lb	.06½- .06½	.06½- .06½	.06½- .06½
Muriate, 80% bgs., ton	37.15 -	37.15 -	37.15 -
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.06 - .07½
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb.	.18½- .19½	.18½- .19	.18½- .19
Salammoniac, white, casks, lb	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	16.00 -18.00	15.00 -18.00	20.00 -22.00
Soda ash, light, 58%, bags, contract, cwt.	1.15 -	1.15 -	1.32 -
Dense, bags, cwt.	1.17½-	1.17½-	1.35 -
Soda, caustic, 76%, solid, drums, contract, cwt.	2.50 - 2.75	2.50 - 2.75	2.90 - 3.00
Acetate, works, bbl., lb.	.05½- .05½	.05 - .05½	.04 - .05
Bicarbonate, bbl., cwt.	1.85 - 2.00	1.85 - 2.00	2.00 - 2.25
Bichromate, casks, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb	.05½- .07½	.05½- .07½	.07½- .08
Chloride, tech., ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.16½- .17	.16½- .17	.18 - .20
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.08 - .09
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Nitrate, bags, cwt.	2.05 -	2.05 -	1.99 -
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.0265 - .03	.0265- .03	.03½- .03½
Prussiate, yel. drums, lb.	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.60 - .70
Sulphide, fused, 60-62%, dr., lb.	.02½- .03½	.02½- .03	.03½- .04
Sulphite, cyrs., bbl., lb	.03 - .03½	.03 - .03½	.02 - .03
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.05 - .06	.05 - .06	.05 - .06
Dioxide, cyl., lb.	.06½- .07	.06½- .07	.07 - .08
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom. -	nom. -	nom. -
Oxide, bbl., lb.	.27 - .28	.29 -	.36 -
Crystals, bbl., lb.	.25 -	.25½-	.27½-
Zinc chloride, gran., bbl., lb.	.06½- .06½	.06½- .06½	.06½- .06½
Carbonate, bbl., lb.	.10½- .11	.10½- .11	.10 - .11
Cyanide, dr., lb.	.41 - .42	.41 - .42	.40 - .41
Dust, bbl., lb.	.05½- .06	.05½- .06	.07½- .08
Zinc oxide, lead free, bag, lb.	.06½-	.06½-	.06½-
5% lead sulphate, bags, lb.	.06½-	.06½-	.06½-
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.10½-$0.11	$0.10½-$0.11	$0.11½-$0.12½
Chinawood oil, bbl., lb.	.07 -	.07½-	.09½-
Coconut oil, Ceylon, tanks, N.Y., lb.	.04½-	.04½-	.06½-
Corn oil crude, tanks, (f.o.b. mill), lb.	.06½-	.06½-	.07½-
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.05½-	.06½-	.07 -
Linseed oil, raw, car lots, bbl., lb.	.085-	.092-	.138-
Palm, Lagos, casks, lb.	nom.-	.05 -	.06 -
Niger, casks, lb.	nom.-	.04½-	.05½-
Palm Kernel, bbl., lb.	05 -	.05½-	.06½-
Peanut oil, crude, tanks (mill), lb	.07 -	.07 -	.07½-
Rapeseed oil, refined, bbl., gal.	.45 - .47	.45 - .47	.58 - .60
Soya bean, tank (f.o.b. Coast), lb.	nom.-	nom.-	.08½-
Sulphur (olive foots), bbl., lb.	.04½-	.05½-	.07½-
Cod, Newfoundland, bbl., gal.	.40 - .44	.40 - .44	.55 - .57
Menhaden, light pressed, bbl., gal	.34 - .36	.34 - .36	.47 - .49
Crude, tanks (f.o.b. factory), gal.	.17½-	.20 -	.27½-
Whale, crude, tanks, gal.	nom. -	nom. -	- .80
Grease, yellow, loose, lb.	.02½-	.02½-	.04½-
Oleo stearine, lb.	.07½-	.07½-	.08½-
Red oil, distilled, d.p. bbl., lb	.07½-	.08½-	.10½-
Tallow, extra, loose, lb.	.03½-	.03½-	.05½-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.	.48 - .52	.48 - .52	.57 - .60
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Bensol, 90%, tanks, works, gal.	.18 - .19	.19 - .20	.21 - .22
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.12½ - .14	.12½ - .14	.14 - .17
Cresylic acid, 97%, dr., wks., gal.	.54 - .58	.54 - .58	.60 - .70
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.30 - .31
Dinitrotoleun, bbl., lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.26 - .28
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.39 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.68 - .70
Naphthalene, flake, bbl., lb.	.03½ - .04½	.03½ - .04½	.04½ - .05
Nitrobenzene, dr., lb.	.08½ - .09	.08½ - .09	.08½ - .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Para-nitrotoluine, bbl., lb.	.29 - .30	.29 - .31	.29 - .31
Phenol, U.S.P., drums, lb.	.14½ - .15	.14½ - .15	.14½ - .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.50 - 1.75	1.50 - 1.80	1.50 - 1.80
R-salt, bbl., lb.	.40 - .44	.40 - .44	.44 - .45
Resorcinal, tech., kegs, lb.	.70 - .80	1.15 - 1.25	1.15 - 1.25
Salicylic acid, tech., bbl., lb.	.33 - .35	.33 - .35	.33 - .35
Solvent naphtha, w.w., tanks, gal.	.25 - .30	.25 -	.28 - .30
Tolidine, bbl., lb.	.86 - .88	.86 - .88	.91 - .93
Toluene, tanks, works, gal.	.27 -	.29 -	.35 - .....
Xylene, com., tanks, gal.	.24 - .25	.25 - .28	.25 - .28

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	.06 - .11	.06 - .11	.13½ - .16
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.03 - .20	.03 - .20	.05 - .22
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.35 - .36
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb.	.27 - .28	.27 - .28	.27 - .30
Carmine red, tins, lb.	5.00 - 5.40	5.00 - 5.40	6.00 - 6.50
Para toner, lb	.75 - .80	.75 - .80	.77 - .80
Vermilion, English, bbl., lb.	1.55 - 1.60	1.65 - 1.70	1.90 - 2.00
Chrome yellow, C. P., bbl., lb.	16½ - 17	16½ - 17	.17 - 17½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - 08½	.04 - .05
Cum copal Congo, bags, lb.	.06 - .08	.06 - 08	.07½ - .08
Manila, bags, lb.	.16 - .17	.16 - .17	.16 - 17
Damar, Batavia, cases, lb.	.16 - .16½	.16 - .19	.18 - .19
Kauri No. 1 cases, lb.	.45 - .48	.45 - 48	.48 - .53
Kieselguhr (f.o.b. N. Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	40.00 -.....	40.00 -.....	40.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	4.15 -.....	4.95 -.....	5.25 -.....
Turpentine, gal.	.35½ -.....	.43 -.....	.40 -.....
Shellac, orange, fine, bags, lb.	.38 - .40	.38 - .40	.50 - .52
Bleached, bonedry, bags, lb.	.28 - .30	.28 - .30	.36 - .37
T. N. bags, lb.	.16 - .17	.16 - .17	.27 - .28
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	9.50 -.....
300 mesh (f.o.b. Ga.), ton.	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 -.....	13.75 -.....	13.75 -.....

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.19½-$0.22	$0.19½-$0.22	$0.22 -$0.24
Beeswax, ref., light, lb.	.26 - .27	.27 - .28	.35 - .36
Candelilla, bags, lb.	.14 - .15	.14 - .15	.18 - .19
Carnauba, No. 1, bags, lb.	.29 - .30	.28 - .29	.28 - .29
Paraffine, crude			
105-110 m.p., lb.	.03¼ - .03½	.03¼ - .03½	.04¼ - .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton.	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton.	80.00-85.00	80.00-85.00	94.00-99.00
Ferrochrome, 65-70%	.11-	.11-.....	.....
Spiegeleisen, 19-21%, ton	30.00-.....	30.00-.....	34.00-.....
Ferrosilicon, 14-17%, ton	39.00-.....	39.00-.....	39.00-.....
Ferrotungsten, 70-80%, lb.	1.00- 1.10	1.00- 1.10	1.20-.....
Ferrovanadium, 30-40%, lb.	3.15- 3.50	3.15- 3.50	3.15-3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.07½-.....	$0.08 -.....	$0.10775 ....
Aluminum, 96-99%, lb.	.233	.233-.....	.233 -.....
Antimony, Chin. and Jap., lb.	.0665	.07 -	.08 -.....
Nickel, 99%, lb.	.35 -	.35 -.....	.35 -.....
Monel metal, blocks, lb.	.28 -.....	.28 -.....	.28 -.....
Tin, 5-ton lots, Straits, lb.	.244-.....	.22½	.301-.....
Lead, New York, spot, lb.	.044-.....	.044-	.055 -.....
Zinc, New York, spot, lb.	.0385	.04½ -.....	.048 -.....
Silver, commercial, oz.	.27⅛	.29½ -.....	.34½ -.....
Cadmium, lb.	.55 -	.55 -.....	.70 -.....
Bismuth, ton lots, lb.	1.50 -	1.50 -.....	1.00 -.....
Cobalt, lb.	2.50 -	2.50 -.....	2.50 -.....
Magnesium, ingots, 99%, lb.	.48 -	.48 -.....	.85 - 1.10
Platinum, ref., oz.	40.00	40.00 -.....	43.00 .....
Palladium ref., oz.	19.00 - 21.00	19.00 - 21.00	23.00 24.00
Mercury, flask, 75 lb.	82.00	85.00	116.00 .....
Tungsten powder, lb.	1.65	1.65 -.....	1.70 - 1.75

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton.	$6.50- $8.25	$6.50- $8.25	$7.50 $8.00
Chrome ore, c.f. post, ton.	17.00- 20.00	19.00- 24.00	21.50- 25.00
Coke, fdry., f.o.b. ovens, ton.	2.75- 2.85	2.75- 3.85	2.75- 2.85
Fluorspar, gravel, f.o.b. Ill., ton.	17.25- 20.00	17.25- 20.00	18.00- 20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit.	.24 - .25	.24 - .25	.31 - .36
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.35 - .40	35 - .40	.48- .50
Monazite, 6% of ThO_2, ton.	60.00 -.....	60.00 -.....	60.00-.....
Pyrites, Span. fines, c.i.f., unit.	.13 -.....	.13 -.....	.13 -.....
Rutile, 94-96% TiO_2, lb.	.10 - .11	.10 - .11	.10 - .11
Tungsten, scheelite, 60% WO_3 and over, unit.	11.25 - 12.00	11.50 -12.00	15.25 -16.50

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Brass Mill—American Brass Co., Waterbury, Conn., will build addition to mill on Canal St., Ansonia, by day labor. Estimated cost $40,000.

Brass and Copper Products Plant—H. M. Hillman, 188 Flatbush Ave. Ext., Brooklyn, N. Y., manufacturers of brass and copper products, will award contract late August for alterations to storage building at Flatbush and Mrytle Aves. E. Owre, 53 Fort Hill Circle, St. George, S. I., is architect.

Chemical Plant Addition—Charles Lennig & Co., Inc., Richmond and Kennedy Sts., Philadelphia, Pa. (manufacturing chemists), awarded contract for a 1 story, 20 x 56 ft. addition to plant to Chemical Construction Co., Charlotte, N. C.

Chemical Plant—McKeesson & Robbins Inc., W. N. Van Fant, Pres., Grassmere Ave., Fairfield, Conn. (manufacturing chemsits), plans the construction of a plant at Montreal, Que. Initial cost $1,000,000.

Chemical Warehouse — Monsanto Chemical Works, 1724 South Second St., St. Louis, Mo., awarded contract for a 1 story, 92 x 171 ft. chemical warehouse to Woermann Construction Co., 3800 West Pine St., St. Louis. Estimated cost $100,000.

Chemical Plant—Pacific States Pulp & Paper Co., Priest River, Idaho, acquired control of Naso Chemical Co., including 1,200 acres of land containing extensive deposits of sodium sulphite, will begin work at once on a chemical plant, capable of turning out 30 tons of finished product daily, at Okanogan, Wash. Estimated cost $75,000.

Coke Plant—Fields Chemical Corp., 1202 Financial Center Bldg., Los Angeles, Calif., plans the construction of a metallurgical coke plant, initial capacity 20 ton daily at Long Beach.

Compress Plant Addition—Aransas Compress Co., Corpus Christi, Tex., awarded contract for the construction of six units to compress plant, 350 x 400 ft., to C. F. Runck, Corpus Christi. Estimated cost $100,000.

Creosoting Plant — Southern Creosoting Co., Durham, N. C., plans the construction of a plant on Hillsboro Road. Estimated cost $150,000. Will creosote railroad ties, piles, poles and other timbers.

Fertilizer Plant—Canadian Fertilizer Co., S. J. Smith, Mgr., Wallaceburg, Ont., is having plans prepared for the construction of a 1 story, 75 x 300 ft. plant. Estimated cost $50,000. Interested in prices on complete equipment.

Fertilizer Plant—Virginia Carolina Chemical Co., Richmond Trust Bldg., Richmond, Va., awarded contract for the construction of a fertilizer plant at East St. Louis, Ill., to Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $100,000.

Gas Plant—British Columbia Electric Railway & Gas Co., 425 Carroll St., Vancouver, B. C., awarded contract for the construction of a new gas plant consisting of complete coal and gas unit including blending plant, wharf, coal handling plant, etc., to Gas Chamber & Coke Ovens Ltd., London, England. $700,000. Condensers, exhausters, scrubbers and purifiers not yet awarded.

Gas Plant — New York and Richmond Gas Co., 691 Bay St., St. George, S. I., N. Y., plans the construction of an illuminating gas plant at Sycamore St. and Richmond Ave., Eltingville. Estimated cost $40,000. Private plans.

Gas System — Sioux Falls Gas Co., Sioux Falls, South Dakota, plans the construction of a natural gas system including storage tanks, regulator stations, etc. Missouri Valley Pipe Line Co., Omaha, Neb., is engineer. All necessary equipment to be changed from manufactured to natural gas.

Gas Terminal and Distribution Plant—Great Lakes Pipe Line Co., Fairfax Industrial District, Kansas City, Kan., awarded contract for the construction of an Ethyl gas blending plant, one 17,500 bbl. and two 30,000 bbl. capacity tanks, loading racks to accommodate twenty railroad cars, etc., to Permanent Construction Co., 208 South La Salle St., Chicago, Ill., also pumping station for pipe line at Corning, Ia., to John W. Whitehurst, Ponca City, Okla., and pipe line to Council Bluffs, Ia., to Truman-Smith, El Dorado, Kan.

Glass Plant—Diamond Glassware Co., H. W. Thomas, Mgr., Indiana, Pa., plans to rebuild glass plant, recently destroyed by fire. Private plans.

Etomology Building—University of California, Westwood, Calif., had preliminary plans made for a 2 story, 70 x 100 ft. citrus experiment station at Riverside. Estimated cost $150,000. G. S. Wilson, 3646 West 9th St., Riverside, is architect.

Laboratory—Buffalo General Hospital, High St., Buffalo, N. Y., awarded contract for the construction of a 4 story hospital, including laboratory, etc., to C. Everitt Inc., 291 Auburn Ave., Buffalo. $220,000.

Laboratory (Forest Products) — Dept. of Agriculture, Washington, D. C., will soon award contract for the construction of a 6 story, 277 x 469 ft. forest products laboratory building, at Madison, Wis. Holabird & Root, 333 North Michigan Ave., Chicago, Ill.

Laboratory (Science)—Long Island College Hospital, Henry and Pacific Sts., Brooklyn, N. Y., plans the construction of a science laboratory, etc. Estimated cost $250,000. Architect not selected. Maturity indefinite.

Laboratories—Board of Education, 911 Locust St., St. Louis, Mo., is having plans prepared for the construction of a 3 story, 400 x 509 ft. high school, including laboratories at Kingshighway and Arsenal St. Estimated cost $900,000. E. T. Friton, Building Comr., c/o Board of Education.

Laboratories—First District State Agricultural & Mechanical College, V. C. Kays, Pres., Jonesboro, Ark., awarded contract for the construction of a 4 story, 145 x 206 ft. administration building, including laboratories, etc., to J. H. Reddick, Fort Smith. $151,598.

Soil Science Building—Rutgers University, J. G. Lipman, College Ave., New Brunswick, N. J., is having plans prepared for the construction of a 2 story soil science building at State Experimental Farm. Estimated cost $150,000. A. Merchant, 1 Elm Row, New Brunswick, is architect. S. Shaw & Co., 24 Commerce St., Newark, are engineers.

Leather Factory—Schell Leather Goods Co., 1015 Race St., Cincinnati, O., awarded contract for a 2 story, 100 x 100 ft. leather products factory on Central Parkway to Parkway Construction Co., 300 Provident Bank Bldg., Cincinnati. Estimated cost $40,000.

Mineral Conversion Plant—W. E. O'Malley & Associates, Cordova, Alaska, plan a mineral conversion plant at Anchorage. Estimated cost $100,000. Owners also contemplate additional units in other mining centers in Alaska.

Paint Factory—Hackmeister Lind Co., Island Ave., McKees Rocks, Pa., will soon award contract for the construction of a 4 story, 60 x 100 ft. paint factory. Lake & Davidson, Negley Bldg., Pittsburgh, Pa., are architects.

Paint Factory — Liquia Fibre Co., 362 Bathurst St., Toronto, Ont., plans the construction of a plant for the manufacture of roofing paint.

Paint and Varnish Factory—Paragon Paint & Varnish Co., 47 10th St., Long Island City, N. Y., is having revised plans prepared for minor alterations and additions to factory at 10th St. and Vernon Ave. Work will probably be done by day labor.

Plant—Brown & Bigelow, C. A. Ward, Gen. Mgr., Quality Park, St. Paul, Minn., is having plans prepared for a 3 story plant for the manufacture of playing cards. Estimated cost $250,000. Toltz, King & Day, 1212 Builders Exchange, St. Paul, are architects.

Paper Plant — Crown-Willamette Paper Co., 830 North Spring St., division of Zellierbach Paper Co., 220 South Los Angeles St., Los Angeles, Calif., awarded contract for the construction of a 1 story, 199 x 315 ft. plant, warehouse and office at East 12th and Evergreen Sts., to Austin Co. of California, 777 East Washington St., Los Angeles. Estimated cost $300,000.

Paper Plant — Everett Pulp & Paper Co., Everett, Wash., has purchased the Cascade Paper Co.'s plant at Tacoma and will place in operation, William Howard is president.

Paper Plant — Superior Paper Products Co., C. J. Bausmann, Pres., Carnegie, Pa., awarded contract for a 1 story, 80 x 180 ft. roll storage building in Robinson Township, to A. A. Lane Construction Co., 1869 East 55th St., Cleveland, O.

Pulp and Paper Mill—Weyerhauser Timber Co., Longview, Wash., awarded contract for motors and control apparatus to be installed in pulp and paper mill at Longview to Westinghouse Electric & Mfg. Co., Lloyd Bldg., Seattle, $20,000.

Kiln — New Jersey Porcelain Co., Pennsylvania Ave., Trenton, N. J., awarded contract for the construction of a tunnel kiln to Ceramac Service Co., 310 West Broad St., Columbus, O. Estimated cost $35,000

Porcelain Plant—C. V. Hill & Co., Pennington Ave., Trenton, N. J., plans the construction of a porcelain plant. Estimated cost $50,000. Architect not selected.

Pottery Plant Addition—S. A. Weller Co., Cemetery Dr., Zanesville, O., awarded contract for a 1 story, 148 x 240 ft. addition to pottery plant to Austin Co., 16112 Euclid Ave., Cleveland. Estimated cost $50,000.

Powder Plant—Giant Powder Co., Olympia, Wash., acquired a site and plans to expend $75,000 in construction of a distribution plant to include a warehouse and dock.

Kaolin Factory—Coen Co., Inc., c/o M. B. Miller & Co., Death Valley, Calif., and Gonzales, Tex., is constructing a kaolin plant. Will mine about 75 cars monthly for shipment to oil refineries. Estimated cost $60,000. Private plans.

Refinery (Gasoline)—G. P. Shelton, et al., Tulsa, Okla., is having plans prepared for the construction of a gasoline refinery, 10,000,000 cu.ft. daily capacity, at Refugio, Tex. Estimated cost $150,000. Private plans.

Refinery (Gasoline) — Tide Water Oil Co., Constable Hook, Bayonne, N. J., awarded contract for the construction of a high pressure cracking unit of tank and tube process, 4,500 bbl. of finished gasoline daily capacity, to Lummus Co., subsidiary of Babcock & Wilcox Co., 85 Liberty St. and Superheater Co., 60 East 42nd St., New York, N. Y.

Refinery (Oil) — Bell Refining Co., Tulsa, Okla., awarded contract for the construction of a 10,000 bbl. refinery near Longview, Tex., to Gregg Construction Co., Longview. $90,000. J. C. Schroeder is construction engineer.

Refinery (Oil)—Dancinger Oil & Refining Co., Pampa, Tex., awarded contract for the construction of a crude oil refinery, 10,000 bbl. capacity at Longview, to Southwestern Engineering Co., Longview. Estimated cost $200,000.

Refinery (Oil)—J. Harris and J. R. Fowler, Seymour, Tex., will build a 300 bbl. oil refinery by day labor. Estimated cost $50,000. Private plans.

Refinery (Oil)—J. Sanger & Associates, San Angelo, Tex., will build an oil refinery by day labor. Estimated cost $25,000. Private plans.

Refinery (Oil) — M. L. Volway, Petrolea, Ont., purchased plant of Canada Crude Oil Producers, at 21 Highway St., and plans to completely overhaul present and install some new equipment. All pumping rigs on this property are electrically operated.

Rubber Factory—Plymouth Rubber Co. Inc., Cemetery Dr., Zanesville, O., awarded contract for addition and alterations to factory unit No. 9 to Platt Construction Co., 711 Main St., Waltham. Estimated cost $40,000.

Rubber Products Factory—Weldron Roberts Rubber Co., 18 Oliver St., Newark, N. J., awarded contract for alterations to factory at 361-65 6th Ave. to Lorenz-Haase, 361 6th Ave., Newark. Estimated cost $40,000.

Soap and Perfume Factory—Lever Bros., 164 Broadway, Boston, Mass., plans remodeling old American Can plant into factory for the manufacture of soaps, perfumes, etc., at Edgewater, N. J. Estimated cost $40,000. Stone & Webster, Inc., 120 Broadway, New York, N. Y., are architects and engineers. Maturity after Aug. 15.

Sodium Fluoride, Titanium Pigment, etc. — Bureau of Supplies & Accounts, Navy Dpt., Washington, D. C., will receive bids until Aug. 18 for lampback, sodium fluoride, titanium pigment, silica, fire extinguishing liquid, acetone, ammonia, litharge, etc., at Navy Yard, Norfolk, Va.

Sugar Refinery—Revere Sugar Refining Co., 333 Medford St., Charlestown, Mass., awarded contract for the construction of a plant unit and drying building to Turner Construction Co., 137 Newbury St., Boston.

Tooth Paste and Antiseptic Plant—Clearing Industrial District, 38 South Dearborn St., Chicago, Ill., awarded contract for design and construction of a 2 story plant to include laboratories, offices, etc., at 6901-03 West 65th St., to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $500,000. Pepsodent Co., 919 North Michigan Ave., Chicago, tooth paste and antiseptic manufacturers, is lessee.

INDUSTRIAL NOTES

BLAW-KNOX Co., New York, has appointed Nicholas Gerten president of the Blaw-Knox International Corp., New York, after serving as sales manager and vice-president.

ARMSTRONG CORK Co., Lancaster, Pa., has consolidated its Cincinnati offices and warehouses at 232 W. 7th St.

FULTON IRON WORKS, St. Louis, Mo., and the GOSLIN-BIRMINGHAM MFG. Co., Birmingham, Ala., have consolidated under a contract with the Whiting Corporation of Chicago.

NORTHERN ENGINEERING WORKS, Detroit, Mich., has appointed R. E. Condit, 705 Gwynne Bldg., Cincinnati, Ohio, and the Hill Equipment Engineering Co., 4620 Delmar Blvd., St. Louis, Mo., as representatives.

ROESSLER & HASSLACHER CHEMICAL Co., has transferred its main sales offices to Empire State Bldg., New York.

GRASSELLI CHEMICAL Co. has moved its New York and export offices to the Empire State Bldg., New York.

LATONIA CHEMICAL Co., INC., Covington, Ky., is the successor to the American Chemical Works, Inc., Cincinnati, Ohio.

NEWARK WIRE CLOTH Co., Newark, N. J., has appointed the Pacific Metals Co., Ltd., representative in Los Angeles and San Francisco, Calif.

THE SWANN CORP., Birmingham, Ala., has appointed George T. Frankle, sales manager at the main office.

BAKELITE CORPORATION, New York, has appointed Martin, Hoyt & Milne, San Francisco, as varnish representatives on the West Coast.

ALLIS-CHALMERS MFG. Co., Milwaukee, Wis., has acquired the assets of the American Brown Boveri Co., Inc., and the Condit Electrical Mfg. Corp., Boston, Mass. Manufacture will be concentrated in Milwaukee and Boston.

B. F. STURTEVANT Co., Boston, Mass., has appointed Walter L. Hunken as representative in Greensboro, N. C.; Philip Cohen in Cleveland, Ohio; and E. A. Engdahl in Seattle, Wash.

U. S. STONEWARE Co., New York, has appointed Lloyd C. Cooley sales representative at 75 E. Wacker Drive, Chicago, Ill.

NATIONAL AMMONIA Co., INC., has transferred its New York office to the Empire State Bldg.

HARDINGE Co., York, Pa., has opened two new offices at 205 W. Wacker Drive, Chicago, Ill., and 235 Montgomery St., San Francisco, Calif.

W. B. COLEMAN & Co., chemical consultants and engineers, have moved their laboratories to 1920 W. Indiana Ave., Philadelphia, Pa.

HEADLEY EMULSIFIED PRODUCTS Co., New York, has appointed J. G. Campazzie as vice-president in charge of sales.

DESPATCH OVEN Co., Minneapolis, Minn., has made the following sales appointments: Jones & Manter Corp. at 120 High St., Boston, Mass.; F. C. Butman, in western New York; and E. B. Wolf, in Detroit, Mich.

REPUBLIC STEEL CORP. has appointed L. S. Hamaker manager of sales promotion with headquarters at Youngstown, Ohio.

PFAUDLER Co., Rochester, N. Y., has appointed H. I. Edwards as representative at Detroit, Mich.; H. C. Wooton in Utica, N. Y.; and E. C. Schindler, in Philadelphia, Pa.

STEDMAN'S FOUNDRY & MACHINE WORKS, Aurora, Ind., has appointed the following representatives: Goggin & Mills, 407 S. Dearborn St., Chicago, Ill.; L. Mardaga, 710 Park Bldg., Pittsburgh, Pa.; J. Y. Riffe, Peoples Bank Bldg., Charleston, W. Va.; Brown, Fraser & Co., Ltd., 1150 Homer St., Vancouver, B. C.; and S. B. Calloway, 3029 Roanoke Rd., Kansas City, Mo.